NATURAL SCIENCE:

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NOTES AND COMMENTS.

Vox Populi.

WHATEVER Mr. Arthur J. Balfour says is interesting, whether one agrees with it or not, and most people will therefore have read the remarks that he made when he took the chair at a recent lecture by Professor J. Shield Nicholson. One of Mr. Balfour's points was the necessity for a separation between science and popular opinion. Questions of science cannot be decided by universal suffrage. Science must be allowed free play and room for growth altogether outside the influence of popular forces. Science must be kept from the vulgar, and the vulgar must be kept from science.

Looking at things, as is his wont, through the clear and rarefied air of philosophy, Mr. Balfour could not fail to apprehend the essential distinction that must always exist between the intellectuality of scientific investigation and the sentiment of popular feeling; he could not fail to discriminate between the attitude of mind that pursues knowledge for its own sake, sacrificing the most cherished convictions of the multitude on the altar of a severe truth, and that very opposite spirit which views all things through the distorting glasses of utilitarianism, seeking always for some advantage either in this world or in that which is to come. Now these two modes of approaching Nature are so distinct that it is quite impossible to unite them. Each is bound to live and move independent of the other. So far, then, as Science is concerned, we do not think that the public will ever spoil her investigations. Mr. Balfour's warning is therefore not required.

When, however, we look at things from a somewhat more practical standpoint, we shall discover many advantages that may accrue to both parties from the promotion of a closer alliance between the two than Mr. Balfour seems to favour. Not merely need we have no fear of injuring Science, but we may even gain for her some additional powers. Scientific men have, or ought to have, a wise diffidence in the stability of their own theories; perceiving how far

the unknown still exceeds the known, they would be the last to rashly alter their conduct in obedience to each variation of belief that appears to be necessitated by each fresh discovery. But they are unable, even if they wished, to keep the new discoveries and the new theories from affecting the larger public. Here a danger lies. This public, vaguely expectant of some message or some new rule of conduct, eagerly grasps at such fragments of scientific theory as are conveyed to it in the diluted form of books like "The Ascent of Man." Then, of a sudden, the vessel of science tacks, and the public, seeing itself left behind, cries out that it is deceived and turns its former praise into ridicule or contempt. Our hope of progress then would seem to lie, not in refusing the laity such crumbs of scientific fact as they may have a fancy for, but in giving them to understand what is the true scientific spirit.

Often enough in these pages we have dwelt upon the aid that can be given to science, not merely by the scientific amateur, but by every member of the public. Intimate relations are bound to exist between the two sides, and instead of withdrawing ourselves into some cloistered calm, we desire to promote those relations that they may enter the phase of a cordial and intelligent affection. Still a warning is needed. It is by no means desirable that those without a proper training should attempt to engage in the more technical branches of scientific work. No one has any objection to people amusing themselves with music or painting, but we do not wish to have our ear distracted by immovable piano-organs or our eye affronted by glaring crudities of advertisement. So with scientific work. There is too much done by well-meaning people that has merely to be undone by the despairing specialist. What we must aim at is to direct the praiseworthy energy of these good folk into channels of more service to us and of no less profit to themselves.

THE BRITISH ASSOCIATION.

IN extending the brotherhood of Science, not merely among the workers themselves, but also, as just intimated, with the world at large, one of the more important instruments is the British Association. For this Association, unlike some others which have been founded in imitation of it, has never forgotten that one of its chief aims is to introduce the facts and principles of Science to those who would otherwise pass them by as belonging to a sphere other than their own. And this idea is really the explanation of much that some of the more ascetic enthusiasts occasionally object to in the working of this organisation. . The popular lectures, the social gatherings, and even the picnics play their own good part in the production of a better understanding between the usually indifferent public and those whom they welcome as dreary pedants, but part from as good fellows like themselves.

At the least it is admitted, even by the grumblers among us, that this annual gathering extracts for Science an amount of nutriment in the shape of golden guineas not altogether to be despised. But what we would rather lay stress upon are such benefits as the fresh impetus given to scientific investigation in each place that is visited, the friendships that professional workers often form with local amateurs, and the general awakening of the public to the fact that, if on the one hand Science helps them, it is, on the other hand, well within their power to offer in return help in many ways previously unthought of. Looking at the matter from these two points of view, there are certain considerations that we may take this opportunity of bringing to the notice of our readers, many of whom will doubtless shortly be attending the meeting at Oxford.

Firstly, as regards the matter brought to the notice of the Sections. It may not be too late to express a hope that contributors of papers to the forthcoming meeting will remember that there is a large body of members who expect entertainment other than the customary highly complicated paper dealing with minute details in an obscure corner of scientific work. Many people bring dry papers which would rapidly empty a learned society, and void them on a respectable hard-working audience which has come to hear some new thing that is addressed to their intelligence. The aspect of the audience, if it remain under such an infliction, is generally saint-like and resigned; in fact, a British Association audience is one of the very best in the world, and all rightly thinking and feeling people hate to see it tortured. One of the things most appreciated in the past was the formal discussion of some selected subject. This was brought into contempt, principally, if our memory serves, by a discussion on stays some years ago; and while it might be advisable to refrain from inviting a possible recurrence of such demoralisation, something ought to be found to take the place of the "discussion." The secretaries of Sections have an opportunity here of improving the meetings by bringing together the papers on allied subjects, having them read without comment at the time, and finishing up each group of papers with a general discussion of them. It would save time, give wider scope to discussion, and make things more interesting to the outsider and probably to the scientific Pharisee as well. A time limit should be fixed for each group of papers, and the discussion of them could be announced in the daily journal; thus members would learn not only where they were, but where they wished to be at given times.

Turning now to the finance of the Association, we hope that someone will raise the question of the invested funds at the general committee. A representation as to this matter was recently made to the Council by a body of scientific men of exceptional weight, and it was pointed out that the invested funds greatly exceeded the necessary amount set aside against liabilities to life-members. It was asked

that the balance should be used in the lean years of the Association to supplement the grants-fund. The present position of affairs is unbusinesslike and deserves another description than "cautious," for which quality some praise it. Every penny, beyond the reserve fund to secure liability to life-members, should be spent. The Association has no authority to treasure it up for posterity; the money belongs to the contemporary members, who wish to see it put to useful work.

Among those to whom we have previously alluded as perplexing Science with their unwelcome attentions, a foremost place must be assigned to the British Association "crank," that peculiar type which appears annually for one crowded week of glorious activity and hibernates—no man knows where. The delicate question of dealing with these dear people has always an importance at a great meeting, such as the Oxford one will be. Many things have been tried, closure, etc., etc.; but the most successful is an enterprising, courteous, spirited, and ingenious secretary attached to a Section for this special duty. The system has its drawbacks, since, in one instance of marked success, the zealous official in question had actually to flee from the vengeance that awaited him when his wiles were discovered, and he has not dared to show his face again at a British Association meeting. But the cranks come back.

THE MARINE BIOLOGICAL ASSOCIATION.

AMONG scientific institutions that justly seek for the aid which, as we have said, the public can so well bestow, must be mentioned the above Association, which has just distributed a letter signed by the President, Professor Lankester, and the Hon. Secretary, Mr. G. H. Fowler, accompanied by a brief biography of the Society. As is the case with most of our scientific societies, the Marine Biological Association has not, by any means, too large an income for its needs. Considering that the Government recognises the importance of the investigations, carried out under the direction of the Council of the Society, in economic questions affecting our fisheries, by an annual grant of money, it is to be hoped that the public will individually reply to the appeal of the Association. The cost of membership is not large—one guinea per annum—and a considerable extension of the list of members would remove many restrictions to the usefulness of the laboratory. The researches carried out have resulted in a great deal of information with regard to such important matters as the size at which various food-fishes reach maturity, which should lead to useful legislation on the artificial fertilisation of fish, the history of the sardine, which has been shown to be simply a pilchard one year of age, and so forth. The more purely scientific work cannot be supposed to appeal to the public at large, important though it is. But those persons who appreciate the morning sole and the midnight lobster

might be expected to further the more abundant supply of these dainties. The efforts of the Association in breeding and protecting these and other food-fishes, backed by legislation against their unnecessary destruction, will unquestionably improve our fisheries; but there is a need for increased financial support—the total income being at present only £2,199, as against £70,000 which the United States Fish Commission gets from the American Government.

Natural History as a Recreation for Sailors.

We have mentioned the aid that laymen can render to Science, and few of them have better opportunities for observing natural phenomena and natural objects than they that go down to the sea in ships. And yet we have often been surprised at the small amount of collecting and observing that is done by Naval men in comparison with their brothers of the Army, although in distant parts of the world both alike have time on their hands and freedom to use it. Of course, we do not now refer to those special exploring expeditions like those of the "Challenger" and the "Blake" in recent years, or the long-sustained explorations of the French in the early part of the century, but to the private collection that is or might be done by those stationed abroad; and India in particular comes to our memory. We are therefore glad to see, in the *Nautical Magazine* for May, a short paper with the title that we have placed at the head of this note. It is written by Captain D. Wilson-Barker, who, as captain of the training-ship "Worcester," has excellent opportunities of instilling into the young mind some appreciation of the beauties and interests of marine animals and plants; and it is to be hoped that our future race of seamen will be more prolific in collectors than that of the past has been.

We are especially interested in one paragraph in this paper, and that is the following:—"It is curious to see the particular whale which frequents this coast [Brazil], and has very long pectoral fins, gambolling about, waving high in the air those long fins, which, in the distance, glisten like gigantic sword-blades." In our March number, it will be remembered, Mr. Lydekker gave an account of a whale-fight off the same coast. Captain Wilson-Barker says, in a letter he has been good enough to send us, that he had an opportunity of observing these whales for eight months while repairing cables off Brazil. He says the pectoral fins, which nearly reach twenty feet in length, are constantly mistaken for threshers; the outer surface, in common with the whole upper part of the whale is black; the inner surface, in common with the belly, is a glistening white. He therefore suggests that the distinct colouring of the inner and outer surfaces of the fin, alternately exposed during the gambolling of the whale seen by Mr. Lydekker, would give the impression of there being two distinct animals. And this interesting note seems to carry conviction.

THE WORM, THE GASTROPOD, THE CORAL AND THE BIVALVE.

STRANGE as any fairy story is this other true tale of the sea that Mr. E. L. Bouvier tells in *Comptes Rendus* for July, 1894 (vol. cxix., pp. 96-98). Once upon a time it was supposed that certain Madrepore corals, named *Heterocyathus* and *Heteropsammia*, built their skeleton around the shell of a living shell-fish, which prolonged its naturally-coiled shell in the form of a tube through the enveloping coral; and this was the opinion of Deshayes, Milne-Edwards, and Haime. This, however, was not quite correct, as Mr. Bouvier is now able to prove from material collected at Aden by Dr. Jousseaume. The curious facts are as follow.

The polyps of *Heterocyathus* and *Heteropsammia* fix themselves, probably at the close of embryonic life, on the minute but empty shells of various species of Gastropods. As soon as each shell is chosen by a polyp, it receives a new guest in the person of a young worm called *Aspidosiphon*, one of the Gephyreans. The little worm enters the shell and rolls itself in a corresponding spiral. Then the coral outside and the worm inside grow simultaneously. On the one hand, the coral soon completely covers the shell and threatens the imprisonment of the worm; but the worm, on its part, continues to grow in the form of a loose spiral, and thus prolongs the coiled cavity of the shell through the tissues of the coral, passing to the exterior by a round opening. At the same time, the worm secretes a tube, which appears at first to be an actual continuation of the shell, but which differs from it by its less thickness, its more intimate union with the skeleton of the coral, and by the rougher appearance of its inner surface. In *Heteropsammia* this tube usually reaches the external opening; but in *Heterocyathus* it is formed more slowly and does not reach the exterior. This single external opening is, however, not enough to bring aërated water for the respiration of *Aspidosiphon*, so it sets to work, apparently by a secretion from glands in its skin, to dissolve long perforations through the substance of the coral.

The worm has a long proboscis, terminated by a crown of short tentacles, and covered with several rows of pointed hooks. It can thrust out this proboscis to catch its prey, and by sticking its hooks in the ground, can, as Dr. Jousseaume has seen, drag along itself and partner. The worm has also two stout horny shields, one of which is placed near the anus at the base of the proboscis, and, when the latter organ is drawn in, it serves to close the opening of the tube. The other shield is at the other end of the animal, and its particular use is not known. The *Aspidosiphon* that lives with *Heteropsammia* is a different species to that living with *Heterocyathus*.

But we are not at the end of the story yet. A home having been thus prepared by *Aspidosiphon*, a little bivalve mollusc called *Kellia*, which seems given to these lazy habits, comes and takes lodgings in the depressions of the tube, and boards on the food that

comes in through the respiratory perforations above mentioned. Mr. Bouvier compares the commensalism of the worm and the coral with that existing beween *Parapagurus pilosimanus* and colonies of *Epizoanthus*. Similarly, the commensalism of the bivalve and the worm may be likened to that obtaining in South Australia between *Ephippodonta* and a burrowing shrimp.

Science at a Picnic.

If we have ventured to say a good word for the much-abused garden-parties and excursions of the British Association, we have no wish that such license should be extended to other bodies which are of a somewhat similar character, but which differ in the fact that the primary objects of their meetings are work and discussion.

In our news column we give some account of the work done at the recent meeting of the Museums' Association. Next year the curators are to meet at Edinburgh, and we trust that the local committee of the northern capital will learn a few lessons from the Dublin meeting. Irish hospitality was so generous and overwhelming that it seriously detracted from what should have been the first business of the meeting, the reading and discussion of papers and practical proposals. It will scarcely be credited that, though the members spent the best part of a week in Dublin, the time allotted to the long list of papers, which included many besides those we have quoted, was only five hours. Considerable complaint was heard at the way in which both papers and discussion were, in consequence, burked; while the insertion of a day's excursion between the two days of meeting proved vexatious to those who could ill spare their time even for the serious business of the Association. We think we cannot do more good to this hard-working body than by ventilating these complaints, which gratitude to its unwearying hosts would otherwise stifle.

Very similar is the cry that comes to us from the Antiquaries in congress at Burlington House. In a paper that went straight to the point, Mr. St. John Hope protested against the elaborate lunches that waste much of the time at local archæological meetings. Clear explanations of the facts that they went to study were enough to attract an audience without the addition of gratis meals. His experience was that intelligent appreciation was usually shown by an audience composed largely of working-men, which was in marked contrast to the listless inattention and often rude indifference of folk calling themselves ladies and gentlemen. Another objection to too great an acceptance of local hospitality was that they might become a tax upon the places they desired to visit. We ourselves remember an occasion when, out of a large party, only two individuals examined an interesting geological section, which the party had travelled many miles to see, but which they were hindered from studying by the prior attractions of welcoming speeches and lunch.

THE LIFE OF MUSEUMS.

MENTION of the Antiquaries in the same paragraph as the Museums' Association reminds us that the former seem strangely ignorant of the existence of the latter. At all events, the upshot of a discussion on local museums, which they carried on the other day, was the appointment of a committee to investigate the questions of arrangement and financial support and the working of the Museum and Free Library rate. It is an admirable thing that the archæologists should treat provincial museums with a proper seriousness, but all these questions have been discussed over and over again by the Museums' Association; and if these gentlemen are really so interested in the subject, how is it that none of those who spoke at the congress or who have been elected on its sub-committee have, so far as we can gather, with the exception of Mr. Ward of Cardiff, ever attended the meetings of that Association?

A propos of local museums, we have received a copy of the *Yorkshire Weekly Post* for June 23, in which the Science Editor, Mr. G. W. Murdoch, has some very sensible remarks on the better utilisation of those institutions. After alluding to the usual difficulties with which provincial (and we may add other) museums have to contend, such as too great enthusiasm for one section to the neglect of others, the lack of local financial support, government by illiterate town councillors, the vanity of donors, and the utilisation of the museum as a convenient rubbish heap, he proceeds to enlarge with much approval on several remarks of our own. From his own examination of many museums, both at home and abroad, Mr. Murdoch has, we are glad to find, come to the conclusion that a museum is of greatest value for the cause of Science, and best fulfils the purposes of its being when it is intimately connected with active teaching and original investigation. The account, which we are fortunately enabled to publish in this number, of the University Museum at Oxford will show that a museum which thus co-operates with the laboratory need never fear comparison with museums that confine their functions to those of the store-room and the holiday entertainment. The ideal museum would, in our opinion, be the intermediary between its own collectors in the field and its own researchers in the laboratory, with its exhibition galleries daily open to neighbouring students, and its reserve collections always ready for the inspection of specialists from every part of the world.

WINCHESTER ONCE MORE.

FROM a leading article in the last number of the *Wykehamist* we learn that the new Museum at Winchester College, to which, by the way, Mr. Murdoch alludes, is to be worked on such lines as we here advocate. "We hear talk," says the school journal, "of rooms for photography, modelling, drawing, and practical natural history, quite

apart from the exhibition rooms. It is to be a home not only of art, but of artists; not only of 'bugs,' but of bug-hunters; not only of fossils, but of those who are qualifying for fossilhood." But will so admirable an ideal, which would render this Museum a true temple of the Muses, ever be attained? We sadly doubt. We leave Wykehamists themselves to settle the question of site, as to which they have already begun to quarrel; but we would fain once more express our surprise at the scanty support this memorial of their great founder has met with. William of Wykeham was a scholar and an ecclesiastic, but he was, above all things, a practical man; we can, therefore, imagine no more fitting way of carrying on the very spirit of Wykeham into the centuries to come than by the introduction of this practical intercourse with nature and art into the educational methods of a school that has adhered somewhat too closely to the scholastic traditions of the Middle Ages. £4,319 16s. 2d. is not a large sum for such an object—is, indeed, miserably inadequate; but what is worse is that it has been subscribed by only 402 people, a number barely equal to that of the boys at present in the school. In the interests of Winchester itself, no less than those of modern education, we trust that a few more Wykehamists will come out of the holes into which they have, like the traditional college spider, for the time retired.

Science and Nature.

In our opening paragraph we spoke of the relation that daily grows more intimate between the scientific specialist in his laboratory and the ordinary man in the street or in the field. Here is an example appropriate to the season. For these are the days when tired and thirsty mortals crave above all things the refreshing charms of fruity acids. Were this a Saturday column of the *Pall Mall Gazette*, we would seek the choice word and the apt phrase to do worship before the dear delights of "lemon squash" or those more humble, prepared drinks that owe their flavour and their fragrance to commercial citric acid. An article in the *Kew Bulletin*, published some months ago (1894, pp. 103-108), spread dire consternation among those who grow the lime and the lemon in the south of Europe and in the West Indies; for it related a direct method of producing citric acid from sugar solution by growing therein a peculiar mould. But by the July number of the same periodical the fears of fruit-growers are, for the time, set at rest. On the authority of a distinguished firm of pharmacists, it is said that the practical difficulties of turning a laboratory experiment into a commercial process are so great, that for a long while to come we must continue to look to Nature for our supplies of the fragrant acid. Her Majesty's Ambassador at Berlin writes in the same strain, but with less confidence. The Director at the Manufactory of Chemical Products at Thann, in Alsace, assures her Majesty's representative, through the German Foreign Office, that "certain

difficulties have been encountered which must be overcome before there can be any question of the mercantile utilisation of the process in question." But he also states that the result of experiments "increases the prospect of ultimate success."

This is only another straw showing that the wind is blowing unfavourably to the simple pursuit of agriculture. The sails of farmers and fruit-growers, of gardeners and foresters, must be trimmed scientifically if the ship is to move. In earlier times "to plough and sow, to reap and mow" according to traditional methods was sufficient. In a good season the kindly earth yielded abundantly; in a bad season a hungry population gave a better price. But now, facilities of transport equalise, and therefore minimise, the varying results of the weather all over the globe. And still more, the rapid advance of scientific methods is dogging the heels of slow-moving Nature. Natural products of every kind are being produced more rapidly, more cheaply, and more certainly by scientific aid. "Protection," "Bimetallism," and a dozen other remedies may be beneficial or harmful; it is not within our scope to discuss them. But we lay down an inevitable and indisputable proposition. Unless the agriculturists of England and her colonies choose to train themselves in scientific methods and to banish for ever their easy opportunism, our agriculture will be ruined.

SCIENCE AND ART.

IF Science renders service to those that supply the practical needs of the world, no less can she aid the ministers of its more ethereal pleasures. The debt that the fine arts owe to Science was dwelt upon a few years ago by Dr. E. du Bois-Reymond, whose address, recently republished in the Smithsonian Report for 1891, we have just had the pleasure of re-reading in a copy of that Report sent to us. But it is only at the close of this interesting disquisition that the eminent physiologist asks the question, "What have sculpture and painting been able to do for science in return for its various services?" And then he will hardly stay for an answer. In fact, the difference between the artistic and scientific modes of approaching nature is so great, that we fear no very satisfactory answer can be given. Even in so obvious a sphere as the representation of natural objects, artists, working to the end of art, have, as a rule, not produced results sufficiently reliable to serve the turn of Science; while to refer under this head to the more or less accurate drawings intended to elucidate scientific writings would be a gratuitous insult to Art. Such notable exceptions as have existed only make more manifest the general prevalence of inaccuracy on the one hand and absence of artistic feeling on the other. If some return to nature has been shown by our English artists of this century, oddly enough largely in consequence of the teaching of that very Ruskin who deplores the pernicious influence of science, and calls forth the scorn of Professor Du Bois-Reymond, yet the present

tendency seems to be in quite an opposite direction. Some of our *fin-de-siècle* young men, influenced, it would seem, by Japanese impressionism and Japanese grotesqueness, seem to have forgotten the chief ideal of the Japanese artist, who, like Caleb Plummer, "tries to go as near to nature as he can for sixpence."

An interesting example of the assistance which the accurate yet delightful art of Japan may render to the scientific enquirer occurs in a paper by Dr. C. Schlumberger in the last number of the Memoirs of the Zoological Society of France (vol. vii., p. 63, and pl. ii.). The so-called dancing mice of Japan are a breed as to the origin of which there has been some little discussion. The peculiarity of these animals is that they twist rapidly round, apparently in pursuit of their own tails, as kittens or puppies are sometimes made to do with us. This dervish-like habit is supposed to be due to a crook in the brain, a mild insanity perhaps produced by some artificial selection or cross-breeding. Now, Dr. Schlumberger has come across a Japanese *netsuké*, the carved ornament of a tobacco-pouch, which represents a family of these dancing mice. The father and mother and eight little ones are reproduced with the utmost minuteness in characteristic attitudes. The chief interest of this work of art lies, however, in its colouring. The father and mother and four of the young ones have white coats spotted with black; two of the young are quite black and two quite white. The mother and the two white young have pink eyes, while those of all the others are black. Dr. Schlumberger therefore infers that the dancing mice of Japan are the product of artificial crossing between well-defined melanic and albino varieties.

In Old Japan.

A propos of Japan, Mr. F. A. Bather, whose recent report on Natural Science in that country will be remembered by our readers, favours us with the following note:—

"Mr. Kumagusu Minakata, whose knowledge of Oriental science has often been shown in his interesting letters to *Nature*, points out that, in the course of transcribing my notes, I have confused the date of Kaempfer's birth with that of his arrival at Nagasaki. He was born in 1651, and first visited Japan in 1690. Consequently the interval between Kaempfer and Siebold was not 175 years, as stated on p. 24, but 135. . . . Some observations condensed from Mr. Minakata's letters to me may serve to supplement and correct my hasty sketch. So far as the past is concerned, the title 'Natural Science in Japan' should be held to refer to European science, and not to the knowledge that the Japanese themselves had of their own lands and seas. Crude as it was, yet the Japanese, imbued with Confucian maxims, vivified by poetical learning, excited by magical formulæ and anxious for medical knowledge, had a Natural Science of their own, which, though borrowed from the Chinese, was by no means unimproved since its transportation. For instance, Li Shi-Chin's 'System of Materia Medica'—of which the Japanese naturalists were the commentators, as the mediæval scholars of Europe were of Aristotle and Pliny—placed such parasitic phænogams as *Gastrodia*

and *Orobanche* in the division 'Mountain herbs.' The Japanese scholars, though they might be childish admirers of the Chinese authorities, did not hesitate to remove these plants to another division, 'the Fungi.' Though this may seem laughable to modern botanists, still it implies the existence of the idea of parasitism or saprophytism, a conception which must have been based on long-continued observations; and it must be remembered that a European taxonomist so recent as Lindley esteemed physiological functions as of major importance in the arrangement of the vegetable kingdom. Thus the germ of science was not utterly wanting among the naturalists of old Japan. In the days of Kaempfer, it is true, the naturalist, properly so called, was very rare in Japan, the few that existed being rather Confucianist or medical scholars. But when Siebold arrived, the naturalist had already been developed by the efforts of many, among whom Ranzan Ono was conspicuous. This man, eulogised by Savatier as 'le Linné du Japon,' has left as his memorial the great 'Guide to the Study of Materia Medica,' which embodied his researches among Japanese and Chinese literature on botany, zoology, and mineralogy. Iwasaki Tsunemasa, mentioned on p. 25, was his pupil.

"To the causes that I mentioned as hindering the progress of science in Japan, Mr. Minakata adds the inattention of Europeans to what was and is doing in that country. This it was the aim of my paper to help to counteract."

THE HONGKONG PLAGUE.

WE cannot leave the Far East without referring to the plague now decimating the Chinese dwellers in our city of Victoria.

Among us modern sanitation seems to have stamped out some of the deadlier pestilences that once prevailed. In London and most of our large towns, typhus fever, at least in epidemic form, is almost a thing of the past, and it may be doubted whether the oriental plague could obtain much foothold in this country, even if conveyed hither. There is little reason to doubt that this epidemic is identical with the Black Death of the fourteenth century, and the Plague of the seventeenth. As in the case of typhus fever, the essential conditions for its propagation appear to be filth and overcrowding, and in these respects China is probably worse than was our own country in the Middle Ages. That the virus is a living organism few will doubt, and it must be an inspiriting thing to the mind of a bacteriologist to have the chance of studying a mediæval pestilence with appliances and methods of the most approved modern kinds. Professor Kitasato, of Tokio, is already on the spot, and is asserted to have discovered in the glandular swellings a bacillus characteristic of the disease. The details of his observations will be awaited with interest by pathologists, since few could have hoped that the Black Death would ever be traced to its ultimate cause in so modern an organism as a bacillus.

SEWER AIR.

TURNING to similar dangers nearer home, faulty drains and sewer air are among those regarded by the householder with especial

abhorrence. His surprise will probably be no greater than his satisfaction when he learns from the Reports on Sewer Air recently presented to the London County Council by Mr. J. Parry Laws, that this enemy is in many respects less black than has been painted. Mr. Laws' experiments only confirm the results previously obtained by others in this country and abroad, but they will appeal to the Londoner with particular force, as having been carried out in some of the oldest, and, in some instances, the worst of his own sewers. They deal mainly with the number and character of the bacteria of sewer air as compared with those of fresh air taken at the same time in the vicinity, under normal and abnormal conditions. Normal sewage contains enormous numbers of micro-organisms—from four to six millions or more to the cubic centimetre—and it might have been expected that air in prolonged contact with such decomposing and fermenting sewage would have become highly charged with bacteria. In most cases, however, Mr. Laws found, as others had found before him, that fewer micro-organisms were present in sewer air than in fresh air taken at the same time, and, which is more important, that those present were related to and apparently derived from the outside air, and not from the sewage. No effect on their number seemed to be produced by moderate splashing, or, in an experimental sewer, by a considerable increase in the velocity of the air current, or even by drawing air through a sewer which had been kept empty for twelve days.

A mere knowledge of the number of bacteria present is of less moment than an insight into their nature, and an attempt was made in every case to determine the species present. Not only were no pathogenic species found, if we except one or two feebly pathogenic *Staphylococci*, which would not harm us if they could, but the bulk of the species present were of a positively ornamental character, and we read with pleasure that our sewers are inhabited by *Sarcina aurantiaca*, *Bacillus aureus*, and *Micrococcus candicans*. If this be so, it must be admitted that, whatever the injurious effects of sewer air may be, we have no experimental evidence of the presence in it of specific germs derived from the sewage. And in this connection may be noted the well-known fact that sewer men are not more liable to zymotic disease than other members of the community. The baffled hygienist must hence take refuge in hypothetical poisons of a chemical nature if he wishes to explain the deleterious effects of sewer air. The evidence of such injurious action is so strong that it cannot be ignored, and it may well be that the effect is a secondary one, and produced by lowered powers of resistance to specific poisons derived from other sources.

Science and Literature.

Meanwhile we have strayed rather far from Professor Du Bois-Reymond and his views on art. Let us hark back for a moment, for

there were some closing thoughts that caught our attention. A strictly scientific paper need not, he says, be without its artistic aspect; it may "be made as finished a piece of writing as a work of fiction." The qualities demanded are not beauty of phrase and aptness of metaphor, but lucid language, logical arrangement, and a due subordination of the various observations to the conclusion of the whole. "To strive after such perfection will always repay the trouble to men of science; for it is the best means of testing whether a chain of reasoning is faultlessly complete." The popular exposition of science may however, retain the ornamental character of literary art to a greater extent. The literature of knowledge, as a brilliant literary critic of the *Athenæum* calls it, may for these purposes invoke the artifices of the literature of power. The modern rush after scientific and technical education has brought with it an aversion to the other aspects of culture; and the practical pedant of to-day scoffs at literary form as unnecessary, and at the graces of style as "high-falutin." Against this tendency we have always protested, and shall continue to do so. For to see the material world alone is to be blind to one-half of nature.

But if we would ally Science with Literature, let us at least ask that the friendship be mutual; for so then will be the benefits. "Everyone," writes Sir Mountstuart Grant-Duff, "must be conscious of the curious effort in much modern writing to supply the absence of fresh facts and ideas, by saying old things in a new and much more difficult way. For a moment the strange contortions of the writer attract our attention; but it is presently found that his performance is a mere acrobatic feat, proving nothing more than the presence of a certain cleverness. The mind of the reader is neither enriched nor soothed. There is but one remedy, and that is to greatly increase the number of facts with which literature deals." The new facts with which Literature is called upon to enrich her store are those of Nature and Natural Science. "Literature will, in her turn, repay with interest all she gains from a larger commerce with Nature."

FOOD FOR BABES.

THE above remarks of Sir M. E. Grant-Duff are quoted from an introduction that he has written to "A Handbook to the Study of Natural History for the Use of Beginners," which has recently been edited by the Lady Isabel Margesson, and contributed to by many writers. With the aims of this book we have much sympathy. At the same time, we must confess that it is not a little difficult to discover what its exact aims may be. Taken as a whole, the book would appear to be designed as the Natural History Codex of the P.N.E.U., that admirable body to which we have occasionally alluded. But the contributors to it seem to have had very different ideas of the way in which they were to fulfil their task. Some have clearly written for the parents; others as clearly for the children.

The consequence is a book that we should rather hesitate to put in the hands of our own children. For instance, we find it written that adaptation, mimicry, and the like "afford us beautiful opportunities for teaching both spiritual and moral lessons, without objectionable preaching, which go home to the hearts of children in such a way that the lesson, once learned, is never forgotten. For we must remember that children easily get hard and callous when left to themselves," and so on. It would never do to let a child behind the scenes in this way. On the other hand, if the book is for adults—even for parents—it is hardly necessary to tell them how to degrade the study of sea-weeds by turning them into Christmas cards.

We regret that we cannot speak better of this book, for many of the articles are useful in their way, and are on the whole free from the inaccuracies that disfigure most popular works of the kind; for this, indeed, the names of the writers are in most cases sufficient guarantee. Still the undoubted ability of some of the writers renders their articles the more disappointing. That on Zoology, for example, consists of lists of books far too comprehensive, interlarded with this sort of thing,—"Gradually we must pass from considering the bird as an intact unity like one of ourselves, to see it as a marvellous living engine, with many parts or organs, as a great web of tissues, as a vast city of cells—competing and co-operating, and finally as an ensouled whirlpool of living matter, which, though ever changing as streams of matter and energy pass in and out, yet retains its integrity till death comes." We don't wish to use the word "high-falutin" so soon after uttering a *caveat* against it, but this really is a trifle "tall." Then again "The Study of Mosses" is doubtless most fascinating; but who would be attracted thereto by these extracts from the description of a Moss plant? "Its base is fixed in the soil by numerous fine filaments, ... some of these may be above ground and green—these are the *protonema*; others are brown, and ramify in the soil—these are the *rhizoids*. The fruit, to which the term *sporogonium* is applied, consists of a *capsule* containing *spores*, placed either at the end of a stalk, the *seta*, or else sessile among the leaves." The chapter on Fungi is nearly as dreadful.

We can only hope that the parents who are expected to read this book will be able to distil from it something that shall be more suitable than the above extracts as food for babes.

The Attack on the Pole.

The present year will be a marked one in the annals of Polar exploration. Never before have so many expeditions been in the field, and never before have the resources of modern science been so called upon to deserve, if not to command, success. The account of the preparations for the Wellman expedition, with its aluminium

boats and bridges, read like a chapter from Jules Verne, and exemplified the imagination of the American journalist. The news recently brought by the "Saide" concerning this expedition is a little contradictory; for while we are told that the "Ragnvald Jarl" was only six days on its passage from Tromsö to Danes Island, Spitzbergen, and that the sea to the north of that island was remarkably free from ice, on the other hand, we learn that, in the opinion of Captain Johannesen, of the "Smeerenburg," the "Ragnvald Jarl" must have been subsequently beset and crushed by heavy pack-ice. This does not augur well for the immediate prospects of the Jackson-Harmsworth expedition, which, in the opinion of Arctic experts, is in any case starting six weeks too late. Since, however, the party are prepared for an absence of two or three years, a slight delay at the outset will perhaps not affect the ultimate result of the expedition. It is, besides, far more the object of Messrs. Jackson and Harmsworth that worthy scientific results should be obtained than that the Pole itself should be seriously threatened. The expedition is very thoroughly fitted out with scientific instruments, and carries besides several experienced observers, although we understand that at the last moment some difficulties arose with regard to the latter.

Almost simultaneously with the starting of the "Windward," the Peary auxiliary Polar expedition left St. John's on board the steamer "Falcon" for Inglefield Gulf, Greenland, to bring home Lieutenant Peary's party. The vessel will call at Carey Island, where the unfortunate Swedish naturalists, Björling and Kallstenius, came to grief in their schooner the "Ripple" in 1892. Dr. Ohlin, a Swedish zoologist, accompanies the expedition chiefly for the purpose of searching for his two countrymen or their remains. The party on board the "Falcon" is also charged to explore Jones's Sound and to make a chart of the coast. After this it will call for Mr. Peary, and return to St. John's about the end of September.

Whatever else may happen, as all these expeditions intend to observe the aurora on one definite plan, the results to meteorology cannot fail to be of exceptional interest.

THE POLLINATION OF THE YUCCA.

IN May, 1893 (NATURAL SCIENCE, ii., p. 321), we described in detail Trelease's studies on the pollination of the Yucca by the larvæ of the moth *Pronuba yuccasella*. In the Fifth Annual Report of the Missouri Botanical Garden (p. 137), Mr. J. C. Whitten has completed the details, previously incomplete, of the life-history of this interesting insect. He finds that the larvæ make their escape from the capsules, and enter the soil, during the rainy weather when the ground is softened and easy of penetration. He also makes the interesting notes that they do this during the daytime or at night, and not exclusively toward the end of the night, and that they drop quickly down to the ground by means of a silken thread.

I.

The Evolution of the Thames.

PROBABLY nothing has gained for geology a greater number of recruits than a love of the scenery and a desire to understand the origin of the physical features of the district in which one dwells. The arrangement of river systems has been an especially useful irritant; for no one provided with eyes and wits can travel about England without being puzzled by the singular anomalies in the courses of our rivers, which often appear to have been planned before the law that water should manage to find its own level had come into operation. The Exe, for example, rises on the north coast of Devonshire, almost within stone's throw of the Bristol Channel, from which it is separated only by the narrow "Hobby Drive"; nevertheless, it flows right across the county and enters the English Channel, instead of cutting its way to the shore near at hand. The fact that no one is allowed to go through the Hobby Drive without paying sixpence, seemed at first to supply a possible explanation, since as the river either would not or could not pay the toll, it had to go round another way. In other parts of the country the rivers do exactly the reverse, having cut their way through hills when an easy course lay open to them round the flanks. The desire to get at some explanation of these eccentricities which did not assign an element of "cussedness" to the rivers concerned, has given the writer, and no doubt many others, a first interest in geology.

The history of the Thames has been a comparatively simple one, and it has not had to record the sensational revolutions of such rivers as the Rhine or the Hudson, though great differences of opinion still exist as to its age and formation. During the past four years, several very important additions have been made to our knowledge of the subject; but before considering these, it may be advisable to refer to the main geological sequence in the district so as to get a time scale for comparison. The western part of the Thames Basin is formed of a series of clays and limestones belonging to the Oolitic series. These are succeeded to the east by newer beds forming the Cretaceous system, of which the two most important members in this connection are the Chalk and some beds of chert formed of sponge remains occurring in the Lower Greensand to the south of the Thames.

Above the Chalk is a series of sands, clays, and pebble-beds forming the Lower London Tertiaries and London Clay: the latter is covered in places by sands and pebble-beds forming the Bagshot series. After this there is a great blank in the Thames Basin: when the geological record again commences, it does so only with a series of gravels, clays, and brickearths, which rarely contain any fossils except some derived from older deposits. In consequence, their correlation and methods of formation present problems of unusual difficulty. The following table summarises these beds in descending order:—[1]

I.—PLEISTOCENE.

(*a*) *Post-Boulder Clay.*—Brickearths and gravels at low levels in valleys of existing rivers. Most of the molluscs and mammals of existing species.

High-level terrace gravels and brickearths with remains of mammoth, arctic plants, etc.

(*b*) *Boulder Clay.*—Chalky Boulder Clay with fragments of rocks and fossils from the north of England.

II.—PRE-BOULDER CLAY, OF UNCERTAIN AGE.

Newer Plateau Gravels: Gravels containing many northern fragments and quartzite boulders.

Older Plateau Gravels: Gravels with many small quartz pebbles. The "Westleton Shingle" of Professor Prestwich and the Pre-Glacial Pebble Gravels of the Geological Survey.

"*Southern Drift.*"—Partly synchronous with above.

III.—PLIOCENE.

Crags of Suffolk and Sand on Chalk at Lenham in Kent.

IV.—EOCENE.

Pebble Beds of Bagshot series.

The most important recent attempt to solve the problems of the origin of the Thames Valley is that of Professor Prestwich in a series of three papers entitled "On the Relation of the Westleton Beds . . . . and their Extension Inland," published in the *Quarterly Journal of the Geological Society* for 1890. The papers are the result of over 50 years of work, and describe some sections that were closed from examination before the younger generation of geologists saw the light. They are a summary of a life's work by the Nestor of British geologists, and from this, as well as from their intrinsic importance, demand respectful notice.

Professor Prestwich's theory of the sequence of events in the south-east of England is as follows. In Lower Pliocene times a sea spread

[1] In reference to the above table it should be noted that the only bed positively assigned to the Glacial is the Chalky Boulder Clay. The gravels that underlie this are no doubt closely connected with it, but were obviously deposited or re-arranged by water. To avoid ambiguity in the article the term "Glacial" is not used as a time name; and beds are simply referred to as being earlier or later than the Boulder Clay instead of as Pre- or Post-Glacial.

across from Belgium to Kent, and thence to Suffolk, where it continued till Upper Pliocene times. In Kent, this period of submergence was soon brought to an end, before the Crags of Suffolk had been deposited, by the elevation of the great arch that once covered the Weald. As the land there rose the summit was denuded away, and the material was washed down the northern slope as the "Southern Drift." This began in the Upper Pliocene, or at the time of the Norwich Crag, and continued into the Pleistocene. North of the Thames the Pleistocene series began with a marine shingle beach, which extended from Norfolk into Berkshire, and possibly further. The pebble beds in the valley of the Bure, which were included by Mr. H. B. Woodward in the Norwich Crag, and are generally known as the Bure Valley beds, are taken by Professor Prestwich as the type of this marine shingle. He has traced it from the Bure across Suffolk to Braintree, and regards as its southern extension the high level pre-Glacial gravels marked in red on the maps of the Geological Survey. These occur scattered over the higher hills of south-west Essex, Middlesex, Hertfordshire, Buckinghamshire, and Berkshire. The land then rose, and the erosion of the valleys of the Lea, Colne, etc., commenced; at the same time, the climate became more and more arctic, until it culminated in the "Glacial Period." The Chalky Boulder Clay was then deposited in the district by an ice-sheet from the north. Still later the Chalk escarpment was formed, and the Thame and the Isis flowed northward along the valley at its foot, and entered the Wash. After this the Chalk escarpment was breached at Goring, and the basins of the Thame and Isis were connected with that of the Kennet, and thus formed the Thames. So, according to Professor Prestwich, the formation of the Chalk and Oolite escarpments, and practically the whole of the physiography and river systems of the south-east of England, date from Glacial and Post-Glacial times.

The theory is a brilliant and fascinating one, as it gives a definite historical classification of the drifts, and a working hypothesis with which to determine the relations of a series of gravels otherwise in chaos. Nevertheless, there seems a general consensus of doubt as to the three main positions in Professor Prestwich's argument—viz., (1) The original continuity of the isolated patches of pebble gravel which he has grouped together as the Westleton Shingle; (2) the recent date of the Chalk escarpment and its breaching by the Thames; and (3) the submergence of the whole of the South-West of England below the sea in Pleistocene times. In regard to the first, there can be little doubt as to the former continuity of the Westleton beds from the Bure Valley into northern Essex as far south as Braintree. Similarly, the gravel patches in the London district which Professor Prestwich has referred to the Westleton Shingle all agree in being Pre-Glacial in their general composition, and were doubtless deposited by a common agency at approximately the same period. But the

gap between these and the nearest of the truly marine Westletons is a great one: the most north-easterly of the patches in the London area is at Highbeech, at the height of 370 feet; the nearest of the Suffolk and northern Essex series is 30 miles distant at Braintree, where the gravels are at the level of 240 feet. There seems, moreover, a considerable difference in the gravels of the two areas: those of the northern Essex and Suffolk group are probably truly marine, whereas, in the case of those of the London district, there seems no evidence to refer them to the same agency, except their gradual rise when followed to the south-west. The acceptance of the correlation and original continuity of the two sets of gravels in these two distant areas is essential to Professor Prestwich's hypothesis. It is almost impossible actually to disprove this, but the evidence in its favour is at present very limited.

The view that the whole of the South-East of England has been submerged below the sea in Pleistocene times is also one that has not found much favour. Messrs. Monckton and Herries, for example, certainly do not accept any submergence of the district in Essex around Brentwood and Warley since Eocene times (no. 3, pp. 22, 23; nos. 4 and 5). It may be objected that the patches of sand on the North Downs of Kent and Surrey, which are referred to the base of the Pliocene series, prove a subsidence at this period; but as far as I am aware, the only one of the patches certainly marine is that in the neighbourhood of Lenham, east of Maidstone. This may indicate merely a gulf running from the Pliocene sea up the valley of the Swale. There is no proof whatever for the Pliocene age or marine origin of the sand patches elsewhere on the North Downs, such as that at Coulsdon.

Nevertheless, in spite of the general hesitation expressed, it seems impossible to get any one piece of direct evidence that is final against Professor Prestwich's conclusions. His theory is founded mainly on a series of inferences rather than direct proof, and inferential evidence is all we have against it. Dr. Hicks's (6) demonstration that the Hendon Chalky Boulder Clay mantles the surface and slopes of Pre-Glacial hills and valleys, and Mr. T. V. Holmes's discovery of Boulder Clay at Upminster (8), showing that at least two-thirds of the Thames Valley had been eroded before the Chalky Boulder Clay was deposited, are neither of them final; for Professor Prestwich fully admits a considerable amount of erosion before the Chalky Boulder Clay, but later than his early Pleistocene Westleton Shingle. Both the cases described by Dr. Hicks and Mr. Holmes are to the south of the Westleton line, and far from the great Chiltern escarpment, on which the point in dispute must turn.

There are, however, two areas which give strong *à priori* evidence against the truth of Professor Prestwich's theory. These are the Chiltern Hills and the Downs of western Berkshire, the structure of which we will now proceed to consider.

The most instructive area in the Chilterns is that in the neighbourhood of Tring, Prince's Risboro', the Wycombes, and the valleys of the Missbourne and the Chess. It is all included in sheet no. 7 of the maps of the Geological Survey, of which the "Drift Edition" admirably shows the complex series of gravels in the district. These are also described in two of the Survey Memoirs (1). The map shows that the Chilterns consist of Chalk, covered by a varied series of drifts, intersected by a number of valleys which cut across the ridge from north-west to south-east. The most extensive of the drifts is a series of gravels and brickearths that are coloured pink on the map and marked as "Glacial." There is no Boulder Clay in this immediate district, but the gravels, though somewhat different in composition, appear to be continuous with those which pass under this deposit further to the east. They are, therefore, earlier than the Boulder Clay. Though marked as "Glacial," no one would be likely to maintain that they are Glacial in the same sense as is the Boulder Clay. They are certainly due to water action in some form, instead of to the direct agency of ice like a moraine. To avoid the ambiguity involved by the use of the term "Glacial," it may be advisable to call these the "Newer Plateau Gravels." They must be distinguished from another set, which may be called the "Older Plateau Gravels," which are the "Pre-Glacial Gravels" of the Geological Survey and the Westleton Shingle of Professor Prestwich. Examples of these occur in this area capping the outliers of Eocene beds at Penn and Lane End, near High Wycombe. The former existence of these two plateaux, each capped by its own set of gravels, was first demonstrated by Professor T. McKenny Hughes in 1869 (9).

A third set of gravels occurs on the floors of the set of valleys running through the Chalk ridge; as these occur right up to the watershed, it is clear that they must have been deposited at a time when the valleys continued further to the north.

The fact that the valleys of Bradenham, Hampden, and the Miss cut through the plateau and contain none of the "newer high level plateau gravels" shows that the valleys are later than the gravels. The valleys themselves, though now dry in their upper parts, breach the Chalk escarpment, and it is impossible to examine them without feeling that they are due to erosion by rivers that once rose some distance to the north. The breaches made by the heads of the valleys are most impressive; thus, that on the road from Wendover to Aylesbury crosses by a pass the summit of which is 503 feet high, while the ridge on either side rises to 790 and 800 feet. Similarly, the road from West Wycombe to Prince's Risboro' crosses through a breach at the height of 427 feet between points of the ridge that are 700 feet only three-quarters of a mile to north-east and south-west. The deposits on the floor of the valley are also suggestive and tell no less strongly in favour of the formation of the valleys of

former streams, for beds of gravel lie along them. Sections in the gravels on the floors of the dry Chalk valleys are scarce and unsatisfactory; there is a small one within the fork of a lane and the main road from Missenden to Prince's Risboro', just to the north-east of Hampden House. The hole shows a coarse gravel of unrolled flints with but little sand and without any oolitic material. Mr. Whitaker records a note by Mr. Jukes Browne upon the gravels at Saunderton in the next valley to the west, which show the same characters (1, p. 447.)

The nature of these gravels is important, as it is to their constitution that we have to trust to know what was the former course of the rivers that eroded the valleys in which they occur. There are two possible explanations: either these streams rose on the Oolites to the north, and are earlier than the Chalk escarpment, or they were confined to the Chalk (as the Chess still is), and existed when this formation extended much further to the north-west than at present. That this latter view is correct appears the more probable, as the gravels of these dry valleys are composed solely of material derived from the Chalk and the "pink" gravels which overlie it. If the head-waters of the rivers had been situated on Oolitic rocks, it is about certain that some fragments of these would occur in the gravels. It might be suggested that these have been eliminated owing to the distance of the valleys from the Oolites; but when we remember that fragments of these rocks occur in the Thames gravels on the south side of the Chalk, and much further from the Oolites than the Saunderton—West Wycombe valley, this explanation seems insufficient. That the valleys are later than the so-called "Glacial Gravels" or Newer Plateau Gravels, we have already seen; but the very irregular nature of the floor of the valley, from which all traces of any former channel have been destroyed, shows that it is of some considerable age. To learn whether the valleys were earlier or later than the Boulder Clay, we must turn to a member of the series which cuts this deposit. The Lea serves our purpose very well; in its upper course it presents identical features with those of the Miss and Chess, while we know that at Hertford the Lea Valley was eroded in the period that intervened between those of the Newer Plateau Gravels and the Boulder Clay, deposits of the latter of which occur within it. If therefore, as seems highly probable, all the north-west to south-east valleys through the Chilterns were formed simultaneously, then the Chalk escarpment was breached in the period between the formation of the Newer Plateau Gravels and the Boulder Clay.

The next point for consideration is as to the evidence to show the age of the escarpment itself. The distribution of the Boulder Clay gives us a good hint in this direction. This deposit was apparently formed by the southernmost portion of the East Anglian ice-sheet, which travelled from north-east to south-west: towards its end it appears to

have split into two tongues, one of which kept to the south of the Chalk ridge, as far as St. Albans, Hendon, and Finchley, while the other flowed along the foot of the Chalk escarpment past Hitchin and Dunstable, whence it trended off to the north-west towards Leckhampstead. The Chalk hills of this district thus rose above the level of the ice which lay upon their lower flanks.[2] This tongue of the glacier seems to have had but little erosive power and to have flowed only along lines of low land previously in existence. Thus in the valleys of the Brent and the Lea it simply occupied pre-existing valleys without eroding fresh ones. As, moreover, it was apparently unable to surmount the Chalk ridge, it does not appear likely that this thin lobe of ice eroded the valley it occupied on the north side of the escarpment. It is much more probable that it there extended so far south owing to the former occurrence of a valley along which it flowed. That is to say that the valley at the foot of the Chalk escarpment, and the escarpment itself, are both older than the Boulder Clay.

We have next to consider the question whether the Thames ever flowed up the valley of the Thame, across the watershed, and down the Ouse into the Wash. Conclusive evidence against this can only be obtained by a detailed study of the distribution of the gravels upon the watershed between the Thame and the Ouse. Until such evidence is forthcoming we are thrown back on two general considerations: in the first place, the great irregularity and sinuous course of this watershed renders it very improbable that it could have been formed by a line of elevation which broke across the former course of a river. Further, the only way in which the Thame could have surmounted the barrier would have been by its waters having stood at a higher level; there is no evidence of any great lake which discharged to the north or of movements of the country which have since lowered the valley of the Thame. Apparently Professor Prestwich's only reason for suggesting this connection between the Thames and the Wash was the difficulty of explaining the formation of the gorge through the escarpment between Moulsford and Pangbourne. But this gorge is simply the southernmost of the series of parallel valleys through the Chilterns. The level of the floor of the gorge is lower than that of the passes through the escarpment further to the north-east, because the height both of the ridge and the passes descend as the former is followed to the south-west. The Thames gorge is so closely analogous to the series of valleys parallel to it, that it appears most probable that it was formed at the same time—viz., before the period of the Boulder Clay. We may summarise, then, the sequence in the Chilterns as follows:—

[2] Mr. Worthington Smith has recently described some drift deposits on the higher parts of the Downs near Dunstable as a "Boulder Clay." This has not been generally accepted as such; and even if it be glacial in origin, as it contains no northern boulders, and is exclusively composed of local materials, it does not prove that the northern ice-sheet ever occurred on the higher parts of the Downs.

(1.) Existence of a high plateau; formation upon this of the "Older Plateau Gravels" of Lane End, Penn, &c. (Coloured red on the Geol. Surv. Maps.)

(2.) Prolonged period of denudation, resulting in the formation of a second plateau, lower than the last, and interrupted at places by hills left undenuded. Deposition on this plateau of the "Newer Plateau Gravels." (Coloured pink on the Geol. Surv. Maps.) The Chalk escarpment was then in existence, but it was much higher and further to the north.

(3.) Erosion of the series of north-west to south-east valleys, including those of the Thames at Goring, and of the Miss, Chess and Loudwater.

(4.) Cutting back of the Chalk escarpment to approximately its present position by the erosion of the Thame and Ouse. This cut off the head waters of the Miss, Loudwater, etc.

(5.) Advance of the ice-sheet which deposited the Boulder Clay.

The only remaining question is whether it be possible to fix any definite date for this series of events. Everyone will admit that no. 5 was early Pleistocene, as it is generally considered that the arctic facies of the fauna in the Norwich Crag was due to the refrigeration of the climate, which culminated in the formation of our English glaciers. This gives us the latest date for the last member of the series. Professor Prestwich includes no. 1 also in the Pleistocene; but if we do not accept his correlation of these drifts with the Westleton beds, then these gravels may be of any age between the Eocene and the early Pleistocene. When we remember how little the structure of the country appears to have altered since the time of the Boulder Clay, it is a rather heavy order to crowd such a long series of events into the short time between the end of the Pliocene and the beginning of the deposition of the Boulder Clay. This affords further reasons against the acceptance of the Westleton age of the "Older Plateau Gravels," which may be allowed an extension backward into the Upper Tertiary, the exact amount of which cannot now be determined.

Let us now turn to the western end of the Berkshire—Chiltern escarpment, where valuable evidence of the Pre-Pleistocene age of the Chalk escarpment is afforded by the distribution of the Sarsen stones. These are huge masses of siliceous rock, now lying scattered over the Downs. Whence they came is not quite decided: they unquestionably represent some former bed of sand, which has now been denuded away and these boulders only left. They vary greatly in composition. They are believed to have been derived either from the Woolwich and Reading or the Bagshot beds, but probably came from more than one horizon. Some of them have been found *in situ* in the former, and thus unquestionably belong to them, while others occur on the London Clay and on Bagshot beds, and thus with equal certainty are far more recent than the Woolwich and Reading beds.

Some, moreover, occur in districts where it is probable that this formation never extended.

The distribution of the Sarsens enables us to approximately determine the original extension of the Tertiary Sands that yielded them. The Sarsens are abundant on both sides of the Kennet valley, on the Marlborough Downs, and thence along a line past Avebury north to Swindon. The blocks here are small, as they are also at Highworth and Hannington. They occur on the dip slope of the Chalk of the Berkshire Downs as far as Aldbourne and Lambourne, but they appear to be entirely absent from the higher part of the Downs. In a walk from Ashbury to Aldworth, along the edge of the Chalk escarpment past Uffington Castle and White Horse Hill, not a single Sarsen stone was seen, except those forming the cromlech and circle of Wayland Smith's cave and the famous "Blowing Stone." These are certainly not *in situ*: the Blowing Stone has been moved to its present position. Nor can I find any record of Sarsens on the escarpment. The highest point at which they occur is one mile from the edge of the Chalk escarpment. Mr. W. Cunnington, who knows the Wiltshire and Berkshire Downs better than anyone, says that their absence from the ridge is certainly not due to their having been removed by man; and my colleague, Mr. Andrews, has recently searched the downs around Aldbourne and can find none nearer the escarpment than on Kingstone Down. Their absence from the escarpment seems to show that the Sarsen-yielding horizon thinned off against the higher part of the Chalk, so that this apparently rose above the level of the water in which these sands were accumulating. The estuary probably extended up the Kennet Valley and then over the lower slopes of the Chalk Downs to Abury, and north of this till it reached the Jurassic plain about Swindon. A further continuation may be indicated by some Sarsens which occur in the valley that runs from Swindon to Hannington and near Highworth. But in any case the Sarsens in the Swindon district are sufficient to prove that at least a part of the Berkshire Chalk escarpment was in existence in the time of the later set of Sarsen-yielding sands, *i.e.*, probably Upper Bagshot.

That the Berkshire escarpment took up its present position earlier than that of the Chilterns is shown very clearly by a comparison of their structure. (Figs. 1 and 2.) Thus, while the Chilterns is jagged and irregular and breached by numerous former stream courses, the Berkshire escarpment is regular and unbroken. The whole drainage system of the Chilterns has been altered since the date when the escarpment was formed, while in the Berkshire Downs the drainage is entirely resultant on the present slope of the country; thus the drainage of the latter is of the type known as subsequent, that of the former as antecedent.

There is a third line of argument which there is only space here briefly to indicate, viz., that the Thames and its tributaries

are essential members of the river systems of England to the south and east of the Humber and the Severn, and that the main outlines of this system were determined long before Pleistocene times. If we examine a map of this portion of England (Fig. 3), we see that all the rivers rise in a central area included within a radius of about thirty miles from Rugby. Hence rivers flow north-east into the Wash and the Humber, south-west into the Severn, and south-east into the Thames. If we examine a sketch-map showing these rivers, two facts are clearly brought out: first, that the drainage lines are dependent on the ridges of the Oolites; and, secondly, that they appear to be independent of the arrangement of the highlands of the chalk in the Chilterns. Thus, while the Thames and the valleys of the Loudwater, Miss, Chess, and Colne run right across the Chalk at right angles to the ridge, and in a south-easterly direction, the rivers of the Oolitic country, on the other hand, flow in the main to

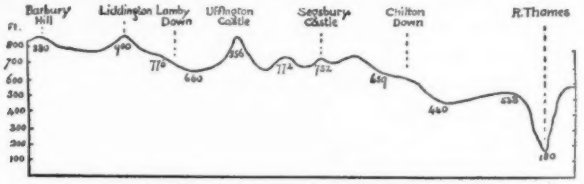

FIG. 1.—Outline of the Berkshire Chalk Escarpment.

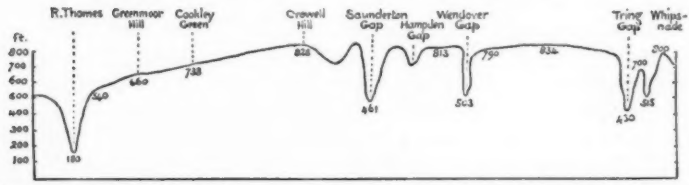

FIG 2.—Outline of the Chiltern Escarpment, showing the valleys of the Thames, Loudwater, Miss, and Colne.

north-east or south-west, parallel to the ridges. That is to say, the river systems of the Chalk country were antecedent to the hills, while in the Oolitic country they were subsequent or simultaneous. This admits of the simple and probable explanation that the rivers rose on a central plateau and radiated thence in every direction, flowing along the lines of least resistance. Those rivers whose course was parallel to the strike of the beds cut valleys through the soft clays, and left the harder limestones standing out as ridges between them. Those which drained the south-eastern slope had to cut their way at right angles to the strike, and thus formed deep narrow valleys through the Chalk ridge. At first these were probably all good sized streams, but the Thame and the Ouse which flowed in the valley between the Chalk and the Oolites cut the escarpment further and further to the south, and thus drained off the headwaters of the Buckinghamshire tributaries to the Thames.

The dates of these various episodes cannot be fixed very precisely. There are two outside limits: the valleys are earlier than the Boulder Clay. They are later than the Newer Plateau Gravels, but it is not possible to determine the exact age of these, for if we reject Professor Prestwich's hypothesis of their correlation with the Westleton beds, then they may extend back indefinitely into the Tertiary. The nearest approach to a determination of a maximum age of the great

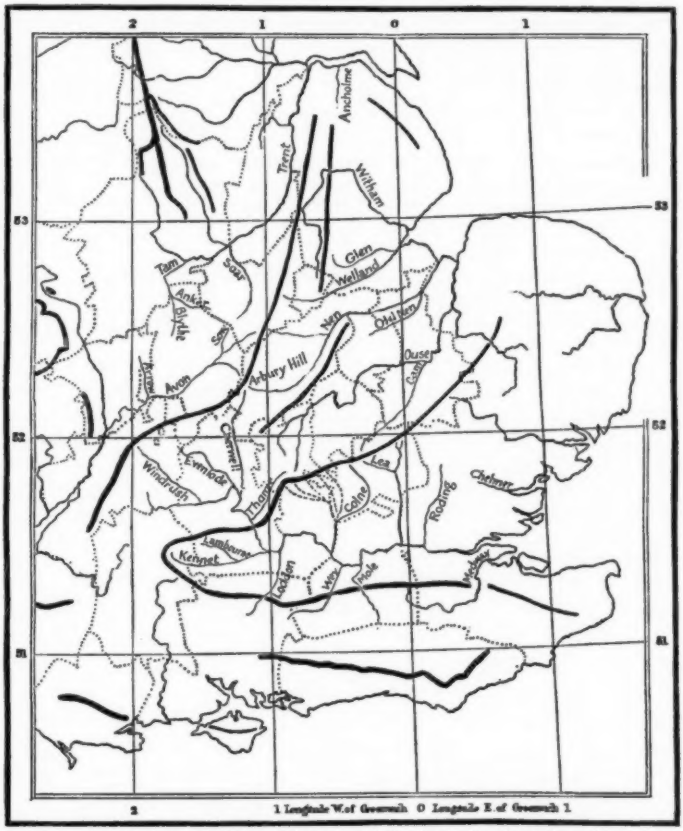

FIG. 3.—Sketch-map of the South-East of England, showing the rivers and principal escarpments (black lines); the dotted rivers are now dry.

central plateau which fixed the direction of the rivers of the south-eastern quarter of England is that it is Post-Eocene; how much later, one cannot be sure. The evidence quoted from the Berkshir area shows that the erosion of the main valley between the Chalk and the Oolites had commenced before the period of the later set of Sarsen stones, which are probably of Upper Bagshot age. So that one can only conclude that the main outlines of the river systems in

question were laid down in the long recordless period which followed the close of the Eocene, when England for the last time "arose from out the azure main." As no deposits of any value as a time scale have been left in this district for this period, it is unfortunately only too possible that we may never be able to arrive at a more exact determination of the date of the Thames and its northern tributaries.

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J. WALTER GREGORY.

II.

Some Account of the Gall-Making Insects of Australia.

THE very interesting paper on the formation of vegetal galls and their inhabitants in the November number of NATURAL SCIENCE has induced me to offer some notes of my observations on the galls produced in this country, and the conclusions I have arrived at as to their origin after close study extending over some years.

The researches of many of our entomologists have shown that the insect fauna of most countries is regulated by, and adapts itself to, its surroundings in a most remarkable manner. Though, in so large a mass of land as Australia, we have a great range of climate and a diversified vegetation, the bulk of this great island is covered with stunted, scrubby forest trees, broken here and there along the coastal mountains and alluvial flats by thick forest lands, and in the north-eastern parts by dense jungles and tropical bushes.

One can safely say that the trees prevailing over nine-tenths of Australia are "gum trees," Myrtaceous trees chiefly belonging to the genus *Eucalyptus*, and smaller shrubby trees belonging to the order Leguminosæ, genus *Acacia*, commonly known under the names of wattles, myal, mulga, etc.

In the genus *Eucalyptus* some 140 species are described, of which the extreme forms are the small, bamboo-like, slender-stemmed mallee-scrub gums, growing up in clumps from a common base, with thin, long, slender roots just below the surface of the dry, sandy country they cover in many of the inland districts, and the giant gums of Tasmania and South Gippsland, whose roots strike deep down into rich alluvial soil, and whose great rounded trunks shoot up 400 feet in height.

The Australian gum trees may be considered as taking the position in our forests that the oak trees occupy in those of England and Europe. As, therefore, on the oaks of the Old World the larger proportion of the most interesting galls are found, so in this country the bulk of ours are produced upon *Eucalypti*. On the western plains and uplands, but also in a less degree in the denser scrubs clothing the coastal ranges, bush fires that devastate miles and miles

of country are of annual occurrence. These, for the most part, do not destroy, but simply char or scorch the foliage of the larger trees, promoting a vigorous growth of young suckers shooting up from the base of the trunks or roots, the tender foliage of which forms a dainty lodgment for hundreds of insects, and is especially suitable for gall producers.

Before proceeding with a brief account of some of our most characteristic galls, we will take a glance at their food-plants, as certain groups seem to have a decided preference for allied species. The Cynipidæ are found upon Acacias and Eucalypts; the galls of the Psyllidæ upon the Eucalypts; the Cecidomyia (gall gnats) attack *Eucalyptus*, *Melaleuca*, *Leptospermum*, *Omalanthus*, *Acacia*, and *Frenela*; while though the greater number of our gall-making coccids confine themselves to *Eucalyptus*, some of the smaller groups also attack *Casuarina*, *Leptospermum*, and *Melaleuca*.

Both the form and the structure of the dipterous galls, all of which belong to the family Cecidomyia, are very variable. One of the commonest, *Cecidomyia Frauenfeldi*, Schurer, about the size of a small filbert, is composed of a number of papery scales overlapping each other like the petals of a rosebud, while the larva lies curled up at the bottom close to the point of attachment to the twig. Very different are the round, hard, shot-like galls of *Horotomyia Omalanthi*, Skuse, often covering the leaves with their rounded reddish warts. The structures of *Diplosis frenelæ*, Skuse, are very remarkable, being subglobular, fruit-like galls, formed of three thin valves growing upon the slender branchlets of the desert pine (*Frenela Endlicheri*).

Those that infest Acacias produce curious tubular galls. *Cecidomyia acaciæ-longifolia*, Skuse, aborts the young seed pods, altering them into irregular masses of tubular cells, each containing a larva, and occurring in such numbers that every seed pod on one of these trees is thus transformed.

Hardly anything is known about the Cynipidæ belonging to this country, but I have described three species (placed provisionally in the genus *Cynips*) all of which are found upon the Acacias, though I know several *Cynips* galls upon the Eucalypts.

Cynips acaciæ-longifolia attacks the flower-buds, aborting them into large rounded soft masses which, when mature, are handsomely tinted with red and yellow, from which they obtain the not inappropriate name of "Acacia apples"; *C. Maideni* produces galls upon the branchlets and twigs of the same Acacia, often altering them into swollen gouty excrescences six or seven times their natural size; *C. acaciæ-discoloris* deposits its eggs in the leaf-buds, which change into oval hollow galls ornamented with three short prongs or horns at the apex.

In the Homoptera, the family Psyllidæ contribute a number of rounded woody galls upon the leaves of the Eucalypts. In one species the larvæ form soft fleshy galls of a brilliant red tint, so

plentiful, sometimes, that the trees appear at a distance to be covered with crimson berries; another simply punctures the leaf and lives in the depression formed round it. This often swells out into an elongate, rounded, bubble-like gall still growing with the leaf after the Psylla has emerged.

I now come to the most remarkable group of our gall insects, namely, the gall-making coccids, belonging to the sub-family Brachyscelinæ. In the typical genus *Brachyscelis*, both the male and female coccids produce some of the most singular and fantastic growths ever found upon a tree. The members of this genus, if not all the Brachyscelids, confine their attentions to the Eucalypts. The male galls are generally small tubular growths from one to three lines in length, very slender, with a dilated rim or bell mouth at the apex; in some species they are very rare or unknown, while in others they cover the leaves in thousands. In *Brachyscelis munita*, Schrader, the male galls grow together, forming a curling, twisted mass of slender truncated tubes without an enlarged apex. I have received specimens of these from country correspondents under the name of "vegetable coral."

In *B. pharatrata*, Schrader, and in several allied species, the male galls are produced from the side of the fully-developed female gall, forming a flattened mass of coalescent tubes enveloped in a smooth fleshy covering, often of a brilliant red tint, ten or twenty times the bulk of the female gall from which it springs.

The larvæ are pale, yellow shield-shaped little creatures, with short stout antennæ surmounted by long bristles of irregular length; the segments are distinct and the outer margin of the whole insect is fringed with short feathery cilia, truncated at the apex, while there are two long hairs or filaments at the anal tip.

The male coccid is a delicate, pale yellow or bright pink, two-winged little insect, with long plumose antennæ and slender hirsute legs. The abdomen is very long and slender, and wonderfully adapted for reaching down to and impregnating the virgin females imprisoned in their woody coverings.

The female galls are produced upon the twigs or branches (exceptionally upon the leaves, as in *B. pharatrata*); they are round, conical, cylindrical, sessile, or stalked, some quite flat on the sides, others angular with apical extremities, produced into long straight or curved horns often several inches in length. *B. duplex*, Schrader, is four-sided, three inches long, an inch in diameter, with two sides prolonged into leaf-like horns from six to nine inches in length, gradually tapering to a point; the apical orifice in this gall is key-hole shaped, and lies between the bases of the horns. *B. munita*, Schrader, is smaller and much more variable; the apical orifice is a minute circular hole with a long, slender, straight or curled horn shooting out from each of its four angles. *B. ovicola*, Schrader, is always a symmetrical oval over an inch in length, while *B. pomaformis*, mihi, known in Queensland as

the "bloodwood apple," has a height of two inches, and a diameter of three.

There is a very curious double growth in *B. pileata* Schrader, and *B. variabilis*, mihi, unknown in any other species we are acquainted with. In the former, a long fleshy spike shoots out, under which the female gall is formed. As it increases in size the spike cracks round at the base, turning into an inverted cup-like covering protecting the young gall; this becomes brown and dry, falling off as the gall beneath reaches maturity. In *B. variabilis* the gall, which is very globose and woody, has a hollow dome-shaped false cell growing around and above the true solid gall. In the latter there is a very small round apical orifice, while in the dome above there is a ragged irregular aperture. Both these species appear to present a case where the outer bark of the stem throws off another gall on its own account.

The female coccids are top-shaped, round at the head, and sharply attenuated towards the anal tip or "tail"; they are yellow or semi-transparent "grubs" with no visible mouth or eyes when mature; short, rudimentary, three-jointed antennæ are situated on a small knob (evidently the head segment) between the fore legs; the middle and hind legs are slightly larger, and all terminate in a simple curved claw; the abdominal segments are distinct, covered lightly with fine hairs, and on the dorsal side carrying irregular rows of short sharp spines (which form very good guides for determining specific differences). From the tip of the anal segment stand out the anal appendages, consisting of two black horny processes lying close together, but tapering and generally cleft at the tip.

The mature coccid is simply a bag of semi-transparent jelly, which changes into a thin transparent fluid, in which the white opaque eggs can be seen, through the skin, floating about; they are extruded in long strings, each egg sac bursting a few seconds after its emergence, when the new-born larva, after a few kicks and struggles, shakes itself clear and crawls down under its mother, remaining inside the gall and often filling the cavity between the wall of the gall and her. After some days they crawl through the apical orifice and escape on to the tree.

If all the thousands of larvæ that escaped from a single gall were able to make good their footing upon the tree, that would succumb speedily to their united attacks; but besides the numbers that never succeed in producing a gall, many that do are destroyed at a very early stage by the attacks of hymenopterous and other parasitic insects.

There are two other genera belonging to this group, *Ascelis* and *Opisthoscelis*. In the former the adult female has no signs of legs or head, but is simply a mass of yellow jelly armed with a remarkable three-fingered anal appendage, which plugs up the apical opening in the flat blister-like or globular gall. The males of *Ascelis* do not produce galls, but remain in the parent gall until full grown.

In *Opisthoscelis* the adult female has the segmental divisions well defined, and though both the fore and middle legs are wanting there is a well-developed hind pair, in which the tarsal claw is produced into a long thread-like joint sometimes much longer than the whole coccid.

Another remarkable genus, *Cylindrococcus*, forms scaly fruit-like galls (which are frequently mistaken for seeds or cones) upon the "she-oaks" (*Casuarina*), while the members of the genera *Sphærococcus* and *Frenchia* form several curious galls very distinct from each other. It is doubtful if the last three genera can be included in the sub-family Brachyscelinæ, but they are mentioned here on account of the gall-making habits of most of their species.

From their minute size it is difficult to observe the larvæ of many of these coccids when upon the plants, but taking one as a type, *Ascelis præmollis*, Schrader, a species rather common about Sydney, found upon the "bloodwood" (*Eucalyptus corymbosa*), we may illustrate how the larvæ of Brachyscelinæ attack the foliage. Upon leaving the mother gall they scatter all over the leaves, but only those fortunate enough to come across the younger growth towards the tips of the branches gain a foothold. They attach themselves to the epidermis, simply sinking into the leaf, the larvæ disappearing in a very short time, leaving the apical orifice, like a pin prick, and a minute blister as the only indications of their presence.

In the case of a parent insect (as in the Cynipidæ) forming an incision in a growing woody tissue, it is quite possible that she might inject some acid or irritant secretion that would have a good deal to do with the ultimate form of the gall; but where the larva itself directly attacks the plant it is quite evident that there can be no irritant matter of any consequence introduced with it, and the final shape of the woody excrescence must be altogether influenced by the mode of feeding or working of the insignificant-looking little coccid.

It is, therefore, very remarkable that a number of white grub-like coccids, with aborted appendages, differing so little from each other in specific characters, should each have the power of forming a distinct and well-defined form of gall, which never varies in size or shape unless attacked by either outward or interior inquilines. The question then arises, What first causes a gall to be oval in one species, and in another species to put forth branching horns?

Their growth is very rapid, and the form of the gall is determined and apparent at a very early stage of formation on the tree. It is quite evident, in the genus *Brachyscelis*, at any rate, that the after-shape of the gall must be anticipated, because the inner skin, or wall of the gall, in contact with the female coccid, is smooth, hard, and sapless some time before its full development. Where the larva is a free-moving creature, it can no doubt materially direct the accumulation of vegetable matter either at the base, sides, or apex of the excrescence by feeding upon or neglecting one portion more than other, and

through an inherited instinct, each insect of a species forms a gall the exact counterpart of the other. This would be marvellous enough, but where the enclosed insect can apparently have no connection with her cell for a considerable portion of the latter part of her existence, it is even more astonishing, and the fact that the form of the galls is influenced at an early stage is borne out by my observations that many attacked by coleopterous and hymenopterous inquilines,[1] which have destroyed the coccid, still grow and increase in the uniform typical shape distinctive of its species.

The excessive flow of sap caused by the intrusion of the larva into the tissue of the leaf or twig would naturally cause an after-growth where the sap-circulation was altered, and naturally would form an excrescence of aborted, diverted, woody fibre, but this cannot account for a mass of galls with long curled horns or other decided characteristics being evolved from such a simple cause. The final shape of the gall must be directed by this tiny organism in some wonderful manner as yet unknown to us.

REFERENCES.

[The full descriptions and figures of the insects and galls referred to by Mr. Froggatt in this article will be found in the following paper by him.—ED.]

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Part ii. *Ibidem*, vol. viii., pp. 209–214, pl. viii., 1894.

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[1] Inquiline: an animal that lives in an abode properly belonging to another, either at the expense of the latter, as in the present case, or merely as a co-tenant.—ED.]

III.

Books of Reference in the Natural Sciences.

OF all the services that can be rendered to the systematic naturalist, the compilation of books of reference is the most useful and perhaps the most thankless. The general value of these books as time-savers is so great, that it is wise in a journal that endeavours to assist scientific as well as general readers to devote a few pages to a list of those works in the various departments of Natural Science which are found by experience to be of service.

To anyone studying a particular group of animals or plants, the loss of time, to say nothing of temper, in hunting up references and getting special information is often considerable, and it must be a satisfaction to know that there is in existence a book in which we can find the greater part of the information for which we are seeking, simply by turning over a few of its pages. It may also, occasionally, raise in the searcher feelings akin to gratitude. Such books should be perfect to be of service; a wrong quotation shakes one's faith in the compiler, and if such often occur, the worker is apt to put aside the book with a sigh. Despite the difficulty of attaining this perfection, there are instances of accurate reference books—*e.g.*, Bronn's "Nomenclator Palæontologicus"—laboriously passed for press, and compared item by item with the original sources, after the manuscript is put into type; for this is the only way to approach exactness. In other cases, the compiler has been known not even to have seen a proof of his work, which has been allowed to go forth into the world with all its errors uncorrected. There can be little use for such books, though they do occasionally put one upon the track of something previously overlooked.

In the following list, no distinction has been made between good and bad books of reference; they have been classified under subjects as far as possible, and notes have been added whenever it has been considered necessary. The list, though obviously incomplete, has been compiled with the help of those most qualified to speak from experience and is offered to those who, working mainly in one field, occasionally wish to stray into another.

GENERAL LITERATURE OF NATURAL SCIENCES.

BRITISH MUSEUM.—Catalogue of Printed Books. This is now nearly complete for the following letters: A—P, U—Z. It is still going through the press, and will be completed in about ten years.

BRITISH MUSEUM.—Academies. An excerpt from *the* Catalogue, and containing all the publications of scientific societies entered under the name of town where published, contained in the British Museum up to 1885.

BRITISH MUSEUM.—Periodical Publications. An excerpt from *the* Catalogue, and containing all the serial publications, other than those of scientific societies, contained in the British Museum up to 1885.

ROYAL SOCIETY.—Catalogue of Scientific Papers. Up to 1883. This contains references to papers which appeared in scientific serials.

ENGLISH CATALOGUE OF BOOKS.—Yearly. Contains titles of all books published in Great Britain and the United States since 1835.

KAYSER.—Index Completissimus Librarum. 1834–1891. A list of all books published in Germany between those years.

LORENZ.—Catalogue général de la Librairie Français, 1840–1890. A list of all books published in France between those years.

BRUNET, J. C.—Manuel du Libraire. 8 vols. Paris, 1860–80. General.

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ANDERSON, J. P.—The Book of British Topography. 1881.

LIDEN, J. H.—Catalogus Disputationum in Academiis et Gymnasiis Scandinaviæ et Finlandiæ. 1778–9. Continued by G. Marklin under similar title up to 1819. Upsala, 1820. [Most valuable for the older Scandinavian dissertations.]

DRYANDER, J.—Catalogus Bibliothecæ Historico-Naturalis Josephi Banks [Banks had a remarkable collection of early books on Natural History: this collection is in the British Museum (Bloomsbury), and is now incorporated in the general Catalogue.]

BÖHMER, G. R.—Bibliotheca Scriptorum Historiæ Naturalis. 1785. Valuable for early publications.

REUSS, J. D.—Repertorium commentationum a societatibus litterariis. Gottingæ, 1801. Gives papers on zoology, botany, and mineralogy published by academies, arranged under subjects.

NATURÆ NOVITATES (Friedländer & Sohn, Berlin).—This is a booksellers' fortnightly list, giving the titles of all publications on Natural History and the exact sciences as they appear.

HUTH & KLITTKE.—Societatum Litteræ. Yearly since 1887. List of current literature on General Science. Frankfurt a. O.

VALLÉE, L.—Bibliographie des Bibliographies. Paris, 1883.

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SCUDDER, S. H.—Catalogue of Scientific Serials. 1885. Includes all publications of academies and societies.

BOLTON, H. C.—Catalogue of Scientific and Technical Periodicals, 1665–1882. 1885.

POOLE, W. F.—An Index to Periodical Literature, 1882; and supplementary volumes. All papers in magazines and similar periodical publications.

[HETHERINGTON, E.].—Index to the Periodical Literature of the World. Yearly since 1890. ("Review of Reviews" Office). Incomplete, but growing.

YEAR BOOK OF SCIENTIFIC SOCIETIES.—Yearly (Griffin & Co., London). Contains complete list of all British Societies with their officers, and details of publications issued during the year.

LEFEVRE-PONTALIS.—Bibliographie des Sociétés Savantes de la France. 1887. Published by the French Government.

MÜLLER, J.—Die wissenschaftlichen Vereine und Gesellschaften Deutschlands. 1883–1887. Comprehensive, but imperfect.

CATALOGUES of the libraries of the following institutions:—Royal, Linnean, Geological, Zoological, Museum of Practical Geology, Science and Art Department, South Kensington Museum, Royal Institution, Patent Office, Radcliffe, York Gate, and all such Catalogues, British and Foreign.

GENERAL ZOOLOGY.

THE ZOOLOGICAL RECORD.—Yearly since 1864. In the volume for 1893 will be

found a list of zoological serials with a note of the libraries where they can be seen.

ZOOLOGISCHER ANZEIGER.—A fortnightly serial containing original matter, but giving a list of new papers and books on zoological subjects as published. An index published in 1887, for the ten years then concluded, gives practically the whole literature of zoology during that time in one volume.

ANATOMISCHER ANZEIGER.—Similar to above, but dealing more especially with vertebrate physiology and anatomy.

ZOOLOGISCHER JAHRESBERICHT.—Yearly since 1879. Similar to the "Zoological Record," but deals with Morphology rather than Systematic Zoology.

ZOOLOGISCHES CENTRALBLATT.—Leipzig, 1894. In progress.

JOURNAL OF THE ROYAL MICROSCOPICAL SOCIETY.—This contains a series of short reviews on recent microscopical work in all branches.

THE NATURALIST, London, publishes classified annual Bibliographies of Natural History for the North of England.

ANNALS OF SCOTTISH NATURAL HISTORY, Edinburgh, contains Bibliographies of current literature on Zoology and Botany of Scotland.

WIEGMANN.—Archiv der Naturgeschichte. Yearly since 1835. Gives a record of zoological literature.

ENGELMANN, Bibliotheca Historico-Naturalis.—From earliest times until 1846; continued as Carus and Engelmann, Bibliotheca Zoologica, 1846–1860; continued as Taschenberg, Bibliotheca Zoologica, 1860–1880 (in progress). This contains a reference to biological literature, either separate or serial, exclusive of botany, and is by far the best and most convenient book ever published.

AGASSIZ, L.—Bibliographia Zoologiæ et Geologiæ. 4 vols. Ray Society. 1848–54. A general catalogue of all books, tracts, and memoirs on these subjects.

Index-Catalogue of the library of the Surgeon-General's Office, United States Army. 15 vols. Washington, 1880–1893. One of the most remarkable catalogues ever published—the papers are entered under both subject and author, and though essentially medical, it is of the greatest use in general biology.

HALLER, A. VON.—Bibliotheca Anatomica qua scriptorum ad anatomen et physiologium facientia a rerum initiis recensentur. Tiguri, 1774.

BRITISH MUSEUM CATALOGUES.—In the recent volumes, *e.g.*, Birds, Marsupials, Snakes, Fishes, Fossil-Fishes, etc., reference is given, as far as practicable, to every described species, whether in the Museum or not.

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C. DAVIES SHERBORN.

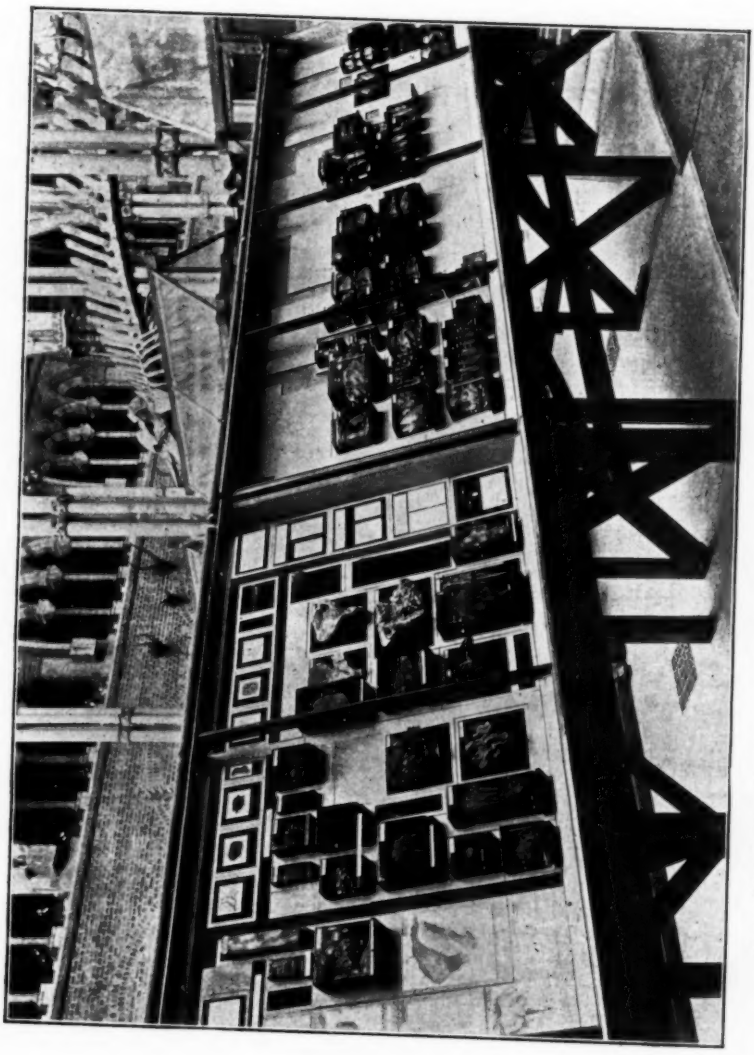
IV.

Some Reforms in the Oxford University Museum.

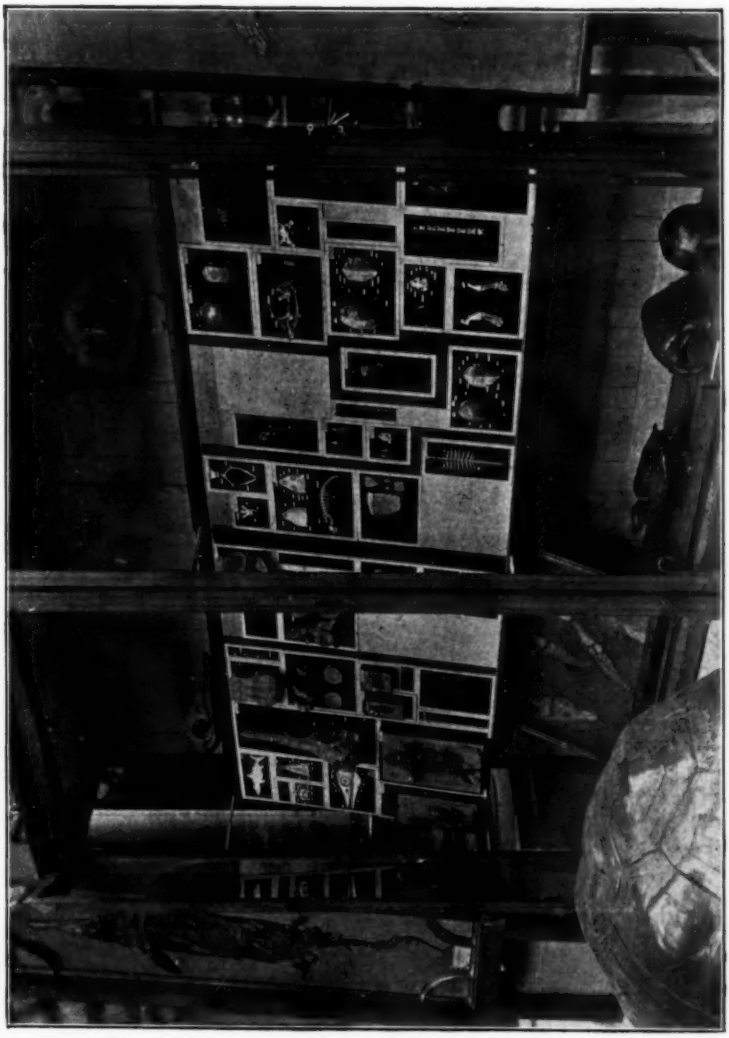
IT is now, I believe, some ten years since Sir William Flower inaugurated the reform of Museums on a truly scientific basis at the Natural History Museum; the cases in the Central Hall, gradually filling with excellent preparations, have been a valuable object lesson for all the scientific Museums in England. On somewhat similar lines, Professor Ray Lankester is reforming those exhibition cases containing zoological collections in the Oxford University Museum which are under his control.

So much has lately been said about the object and aim of Museums that I need only point out those particular conditions wherein this Museum differs from other similar public institutions as regards the kind of collections to be exhibited. Here one need seek neither to attract the nursery-maid nor to amuse children, nor again need one trouble to satisfy the idle curiosity of the sight-seer. There is, then, no necessity for tragic groups of stuffed animals, for birds perched on cardboard rocks among artificial flowers. On the contrary, the exhibits are to be strictly scientific, forming series at once instructive and interesting to the general educated public, and more especially to the real student of zoology. Surrounded as it is by the various chemical, physical, and biological laboratories, the central court is in the first instance a place of study. In such educational collections it is essential that each object should be exhibited for a definite purpose, should show what it is meant to show as clearly as possible, and should be fully labelled in language technical so far as is necessary for accuracy. The observer is not to be bewildered by a number of specimens, but rather impressed by a few well-chosen examples.

For more than 30 years a large and valuable quantity of material (chiefly vertebrates) has been accumulating in this Museum, which, enriched with portions of the Ashmolean, Christ Church, Hope, and other collections, forms a considerable store of specimens to draw upon for exhibition. Hitherto the cases belonging to the Department of Comparative Anatomy had been used rather for storage than for display. The specimens were placed on shelves,



One of the Invertebrate cases; showing, on the left-hand, the arrangement of the Porifera.



One of the Reptile cases; containing *Ichthyosauria*, *Plesiosauria*, and *Chelonia*.

and taken out when needed in the laboratories or elsewhere. A comparatively small number were shown in table cases. Now, two collections only are kept: one, the larger, for educational use in the laboratory and for research, the other, and smaller, for public exhibition. It is with the latter that we have to deal in the present sketch, and with the system adopted for its display. The specimens are placed in their proper systematic order to illustrate not only their structure from a general morphological point of view, but also those important characters of systematic value whereby animals are classified—in other words, not only to show the anatomy of animals and to state that they *are* divided into classes, orders, and families, but also to show *how* and *why* they are so divided. Extinct forms are placed next to their living relatives,[1] and treated in precisely the same manner, thus breaking down that artificial barrier some people are apt to erect between fossil and living animals. When neither specimens nor casts can be obtained, semi-diagrammatic black-and-white figures are set up in their place. Similar drawings are shown of important objects too small to be visible to the naked eye.

Each object is placed on a rectangular tablet covered with black in the centre, with a half-inch margin of soft greenish blue colour all round. The specimens are provided with printed labels, and narrow red "pointers," or lines; when in spirit, they are placed (labels and all), attached to a glass plate within square glass jars, blacked behind. Moreover, each tablet has a small label at the top right-hand corner, giving the scientific and popular name of the specimen, its date, catalogue number, locality, and source (by whom presented, or from whom obtained by purchase or exchange). As already stated, each specimen is placed in its systematic position, and the families or larger groups are marked off by dark red broad lines of separation. The whole presents a *tout ensemble* pleasing to the eye, yet not distracting the attention from what should, of course, be its chief object —the specimens themselves.

It is evident that the arrangement of the whole animal kingdom in this fashion is a task of no small magnitude, which will require some years to complete. Fortunately, in some instances, the help of specialists has been secured, as, for instance, of Dr. W. B. Benham for the Chætopods, Mr. E. A. Minchin for the Sponges, and Mr. G. C. Bourne for the Corals.

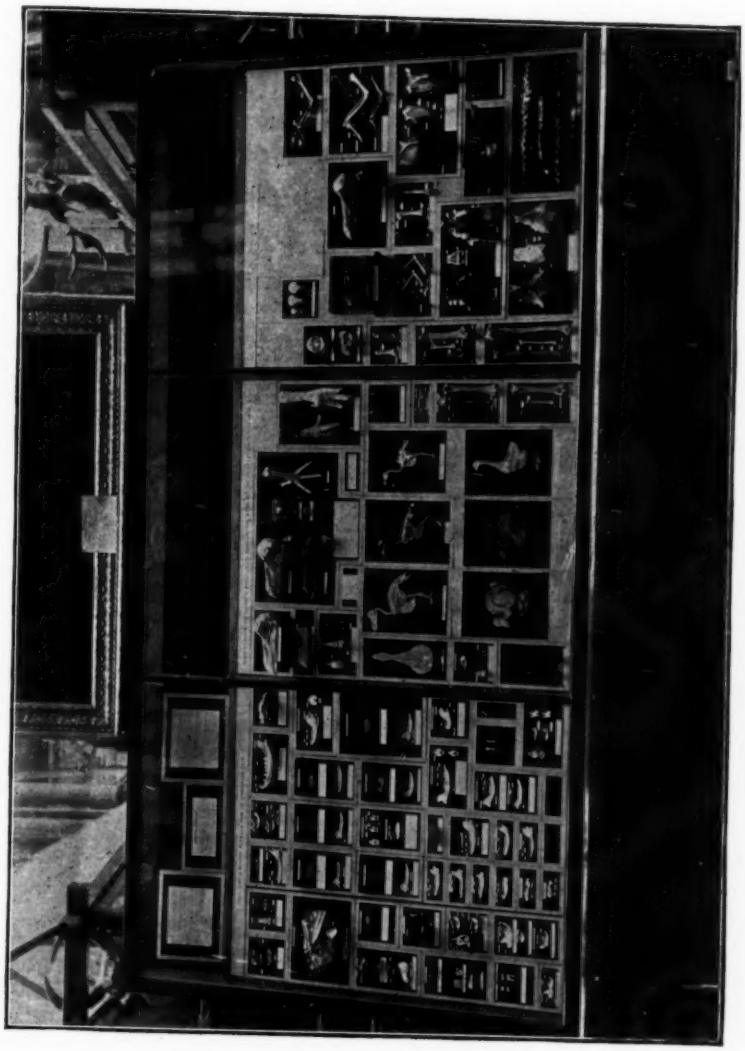
A set of six show cases, about twenty-one feet long, is devoted to the Invertebrates. These cases are provided with sloping backs and glass fronts on either side about four feet high above the ordinary table level, giving in all some 900 square feet of exhibition space (see Plate I.). Of the Invertebrates, a considerable number of Polychætes and Molluscs has been set up; but the Sponges are the only group the arrangement of which has approached anything like

[1] Professor Green has kindly lent many excellent fossils for this purpose.

completion. Mr. Minchin drew up the outline of the plan adopted, and selected the specimens. The Porifera, unfortunately, are a very unsatisfactory class to deal with in a Museum, their most important morphological and systematic characters being microscopical. This is, however, to some degree compensated by the very instructive and plainly visible modification of form assumed by individual sponges. A striking and very complete set of the modifications both of the Sponge Person and of the Sponge Colony has been prepared. Above these have been placed a series of coloured sketches drawn from life at Jersey, showing the brilliant colours of sponges which cannot be preserved. Then comes a series of fully described diagrams of the types of canal system, next to which are the specimens illustrating the classification of the group. (These do not appear in the photograph, being still in another case, where they were placed provisionally.) In this systematic part, short descriptions and figures of the characteristic spicules, etc., are placed at the head of each division.

Turning now to the Vertebrates. These are exhibited in the old high upright cases, within which sloping backs have been fitted. The Reptiles, the class to which most attention has been given, occupy one side of one of the main avenues, appropriately facing the famous *Megalosaurus* and *Cetiosaurus* remains. The tablet space devoted to this group alone is of about 240 square feet. Plate II. shows the case containing the Ichthyosauria, Plesiosauria, and part of the Chelonia. Below are put objects too bulky to be set on tablets, while above will be placed the outline classification of each order, with large and carefully-executed diagrams of the skull. The descriptive labels have not yet been written.

Besides this general collection, a few things of exceptional interest or rarity have been set up in special cases. Such are a series illustrating Craniometry, and another showing the principal points of structural difference or resemblance between Man and the Anthropoid Apes. Lastly, there is a case (Plate III.) containing the Mesozoic Mammalia from the Stonesfield Slate, and the remains of the famous Oxford Dodo, the last Dodo seen living in Europe. This case, which was the first of the new ones completed, is arranged in great detail. In the portion devoted to the Mesozoic Mammalia, we have on the left the Allotheria (Multituberculata), among which we may notice the long-lost fragment of *Stereognathus* belonging to Professor Lankester, which was only recently recovered. On the right are the six jaws from the Stonesfield Slate, with an enlarged drawing, history, and description below each, together with figures of all the British and the most important American genera of Mesozoic mammals. Alongside are placed specimens of those living forms which resemble them most. The largest portion of the case is occupied by the Dodo, the Solitaire, and their living allies. Most of the parts of *Didus* and *Pezophaps* are compared bone for bone with those of pigeons, and their affinities are fully illustrated.



Case containing the Mesozoic Mammalia and the Dodo.

In view of the approaching visit of the British Association to Oxford, it may be useful to mention some of the specimens, besides those already treated of, which are of particular interest to zoologists. Such are, among the mammals: The brain of the chimpanzee "Sally," the jaws of the Ziphioid whales, *Mesoplodon bidens* and *M. layardi*, and a cast of the large extinct American Ungulate, *Dinoceras mirabile;* a Great Auk's egg figures among the stuffed birds; among the reptiles we may mention the Leathery Turtle (*Dermochelys coriacea*), the structure of whose carapace is shown in the reptile case described above; among the interesting fish are *Lepidosiren* and *Chlamydoselachus*, *Palæospondylus* and *Pleuracanthus* of the fossil forms. In the Geological Department there is an excellent collection (that of the late Dr. Grindrod) containing type-specimens of *Pteraspis* and *Cephalaspis*. Among the recent invertebrates we may notice a large series of Cephalopods, some of which are unique in England (*e.g.*, *Thysanoteuthis* and *Dorataspis*); a specimen of the sponge *Crateromorpha meyeri* containing the branching Polychæte, *Syllis ramosa*; a remarkable earthworm with two long penial appendages (of the genus *Siphonogaster*), and some very fine specimens of the coral *Heliopora*. Many dissections and other objects, though mounted, have not yet been set up in the new cases.

E. S. Goodrich.

Oxford Museum, July 14th.

V.

Hertwig's "Preformation or New Formation." [1]

Part I.

DR. OSCAR HERTWIG has worked so long at embryological subjects, and has produced results so valuable, that his opinion on this burning question of to-day is of unusual value. It is proposed in this paper to give an uncritical account of the views expressed by him in his most recent publication.

Biologists of the seventeenth and eighteenth centuries observed the process of embryological development as the growth of a miniature but visible embryo or bud into the adult form. They regarded it, therefore, as a process in which the minute particles of a formed organism became bigger by the absorption and transformation of food-substances. By analogical reasoning they carried these visible occurrences back to invisible beginnings, and came to hold the germ of an organism as a miniature image of the adult, invisible to us on account of the imperfection of our eyes, and by reason of the extreme minuteness and opacity of the germ. They had got beyond the idea of spontaneous generation, and had formulated a theory of the continuity of life in the phrases "omne vivum e vivo," and "omne vivum ex ovo." And so, in addition to the theory of "preformation," they adopted the theory of "evolution." The germ of an animal was a miniature of the animal, and within this, germ within germ, were enfolded the germs of all future descendants of the animal. The succession of the generations of animals was an "evolution," or unrolling of a series of germs arranged by the Creator at the beginning of the world.

In the last hundred years improvement of methods and instruments has carried the boundaries of the visible much further into matter. The embryos and buds which appeared then simple organic substance are now resolved into millions of cells, while these again are

[1] Zeit- und Streitfragen der Biologie. By Professor Dr. Oscar Hertwig. Pamphlet I. Präeformation oder Epigenese? Grundzüge einer Entwicklungstheorie der Organismen. Pp. 144, with 4 illustrations in the text. Gustav Fischer, 1894. Price 3 marks.

ordered aggregates of physical substances. Although in this minuter investigation no trace has been found of enfolding of germ within germ, yet as a logical possibility this theory could only fail when the actual limits of matter had been reached. It remains to-day as it was at origin, unfounded on observed fact, but in the limits of pure reason logically tenable.

Wolff's "Theoria Generationis" was the foundation of epigenetic views. He perceived that preformation and evolution formed a closed system where there was no room for the progress of research. He tried to bring back embryology from pure reason to the realms of observation, and held that the germs of animals and plants were structureless organic matter, which in the process of development by new formation or epigenesis became the organised adult. His theory found little favour in his own day, for he could offer no rounded interpretation of nature in which the mind of man could dwell. He had no explanation of that "vis essentialis," inherent energy, with which he endowed organic matter; on his system the growth of a new organism remained as much a miracle as he declared the theory of germ within germ to imply.

Since his time, succeeding generations have done something to place a real meaning within his inspiring but empty phrase, and in the slow progress of science step after step has been taken in tracing the forces and methods by which organic forms arise. But to-day, as formerly, the same question is answered in two ways. In the words of Roux: — "Is embryological development epigenesis or evolution? Is it a new formation of structure? or is it the becoming visible of structure previously invisible to us?"

Weismann is the great modern instance of those who respond for preformation and evolution. According to him, each cell or set of cells of the adult that vary independently have an actual representative in the germ. The germ is a microcosm in the strict sense of the word, and this microcosm is a miniature of the adult invisible to our eyes. In two respects, Weismann's germinal microcosm differs from that of the older evolutionists. They held it to be a simple and direct miniature of the adult. For us, separated from those times by a century of embryological work, the actual events of embryological development, the visible changes of cell-layers, and the metamorphoses of organs, make this view untenable. And so in Weismann's microcosm the elements representing structures in the adult are arranged quite differently from the adult arrangement. Secondly, the older evolutionists explained the chain of life by their theory of germ within germ. Weismann attributes to his microcosm the power of division. But in method and tendency this modern theory of preformation, like the older theory, stays rather than satisfies the desire for causal explanations, and is on the intellectual level of an "explanation" of the origin of the world by supernatural means.

For many years Dr. Oscar Hertwig has been studying both the

actual occurrences of embryology and their theoretical significance. Since he takes a more epigenetic view, he proposes to attempt to formulate his ideas. This he will do first in a criticism of Weismann's theory of preformation, and then in an exposition of his own epigenetic theory. An account of these two sections will appear in succeeding numbers of NATURAL SCIENCE.

P. CHALMERS MITCHELL.

SOME NEW BOOKS.

MARSUPIALS.

A HANDBOOK TO THE MARSUPIALIA AND MONOTREMATA (Allen's Naturalists' Library). By R. Lydekker, F.R.S. 8vo. Pp. xvi., 302, with 38 coloured plates. London: W. H. Allen & Co., 1894. Price 6s.

IN this volume the author gives a concise account of all the known species of the Marsupialia and Monotremata. Under each specific name we find (1) a list of synonyms, (2) a diagnosis of the species, (3) distribution, (4) an account of the habits and mode of life. Moreover, each family and genus is the subject of a short descriptive account, and the whole is prefaced by a general introduction. The design of the book, which is based avowedly upon Mr. O. Thomas's Catalogue of the Marsupialia and Monotremata in the British Museum, is, indeed, excellent, and renders reference to any point easy. There are both systematic and alphabetical indexes.

In the introduction the author remarks that "it is not to the credit of the present generation that the working zoologist has for the most part to rely for his knowledge of the habits of the greater number of Marsupials upon observations—admirable in their way—published many years ago"; but in spite of this deficiency most readers will be thankful for the very interesting accounts here brought together of the habits of the various species, and we may echo the hope of the author that the appearance of this book may stimulate those who have the opportunities to add to our knowledge in this direction.

The book is thoroughly up to date, and includes descriptions of the more recently discovered species. The most interesting of these is the curious Marsupial Mole (*Notoryctes typhlops*)[1], of which a complete description and a good figure are now rendered easily accessible to the general reader. The affinities of this remarkable animal have been the subject of some discussion, but it is now definitely proved to be a true marsupial, having, however, some striking points of resemblance with the Cape Golden Moles (*Chrysochloris*), which belong to the Insectivora. This similarity is particularly marked in the case of the teeth, and in this connection the author makes a statement that appears open to objection. He remarks that "the exact similarity between the molar teeth of the two is somewhat difficult to explain, although it may probably be accounted for by both having retained this primitive type of tooth from early ancestors." Now, it seems highly improbable, to say the least, that two animals belonging to two totally different groups, both highly specialised in relation to a peculiar mode of life, should have retained the primitive character of the teeth, which so readily undergo modification. It appears far more likely that in these cases, as in many others, the tritubercular teeth are by

[1] *See* NATURAL SCIENCE, vol. i., pp. 37 and 247.

no means primitive, but highly specialised in relation to a particular diet, and that the resemblances between the two animals in question are simply the result of convergence, due to similar environment and mode of life.

The last part of the volume is occupied by a brief account of the fossil forms of the two orders, concerning which Mr. Lydekker can speak with authority. It is to be hoped that a similar addition may be made to the other volumes; the divorce between descriptions of recent and fossil forms has lasted too long already.

Most of the plates were originally published in Jardine's Naturalists' Library, but have been recoloured for the present issue, while figures of some of the recently discovered species are added.

BRITISH PASSERINES.

A HANDBOOK TO THE BIRDS OF GREAT BRITAIN. Allen's Naturalists' Library. By R. Bowdler Sharpe, LL.D. Vol. i. 8vo. Pp. xix., 342, with coloured plates. London: W. H. Allen & Co., 1894. Price 6s.

THE additional interest which nowadays attaches to most natural history topics has naturally resulted in a rapid multiplication of zoological works. This in itself is desirable enough, since students always wish to keep their knowledge abreast of the times. The misfortune is that some of the works which are most loudly trumpeted by the public Press possess little real utility, being, in fact, merely popular compilations of the harvesting of genuine workers in the wide fields of Science. Happily, no such drawback attaches to the charming little volume on British Passerine Birds, designed by Dr. Sharpe to inaugurate the new "Naturalists' Library" which Messrs. Allen propose to launch under his very competent editorship. It is true that books on British birds are legion; nevertheless, there is always room for first-class work, and Dr. Sharpe's exceptional experience stamps his pages with that *imprimatur* of authority which we should look for in vain in many other popular works. Dr. Sharpe has the resources of the national collection upon which to base his conclusions. He is a good field naturalist himself, and possesses a knowledge of modern ornithological literature second to none. It is not, therefore, surprising that his new book has been carefully planned and executed with the highest skill. It is well printed, and misprints are hardly to be found. There are a few trifling slips in Dr. Sharpe's definitions of the ranges of certain birds, but none of these happen to be of any consequence. A more serious drawback is the somewhat inadequate treatment meted out to *nestling* birds. In this respect alone Dr. Sharpe is arbitrary and irregular. For example, he describes the nest-dress of the young Creeper (*Certhia*), but he says nothing about the first plumage of the true Flycatchers (*Musicapa*). The first plumage of the Thrushes (Turdidæ) is fully explained, but nothing at all is said about the first plumage of the Larks (Alaudidæ), which is quite as noteworthy. We should like to see the nest-dress of every species fully explained in the volumes which are to follow. When we turn to Dr. Sharpe's descriptions of the habits of birds, we find such frequent references to Mr. H. Seebohm that a stranger might suppose that this distinguished traveller was our only insular field naturalist. We do not wish to detract from the merits of Mr. Seebohm's labours, which we value very highly; but Mr. Seebohm's field notes have been served up again and again in his "History of British Birds," in his books on Siberia so-called, in the Ibis, in Dresser's "Birds of Europe," while popular com-

pilers have appropriated whole pages of Seebohm's writings in order to use them as padding in their own books. Dr. Sharpe would have done well to lighten his text with a brief extract from Warde Fowler's excellent *brochure* on the habits of the Marsh Warbler, or Gurney's graphic account of the Bearded Titmice that nest (in sadly diminished numbers) in the Norfolk Broads. A long series of excellent papers might have been drawn upon with advantage. After all, we must not be too exacting. It is something of a privilege that Dr. Sharpe should lay aside his important monographs in order to instruct our youth in such a limited subject as "British Birds," and we might seem ungrateful if we found serious fault with the execution of his task. It is only fair to say that Dr. Sharpe has taken great trouble to anticipate the requirements of beginners, as well as the points that advanced students are likely to raise. The characters of each genus are tersely and comprehensively described. The various problems of distribution are discussed and explained with judgment. Every variety of information seems to be afforded by one or other of the separate paragraphs into which Dr. Sharpe has wisely divided his text. The changes of plumage receive full and lucid treatment. The size and colouration of the egg-shells of British Birds are fully described, apparently from the National Collection, which Mr. Seebohm has recently arranged and classified. Altogether, we may say that Dr. Sharpe has been exceedingly successful in his first venture, which augurs well for the quality of the numerous volumes which are to follow. The most grudging critic would find it hard to withhold a high meed of praise from the letter-press. From beginning to end it is nothing less than admirable. Would that it were possible to speak in the same terms of the coloured plates. They are numerous—surprisingly so for the price of the book—and we hope that they may prove useful; but they are not up to the mark by any means. If the series arranged by Messrs. Allen is intended to have a large circulation, we incline to think that the publishers would do well to sanction a more liberal expenditure on illustrations.

American Eggs.

Smithsonian Institution. Comparative Oology of North American Birds. By R. W. Shufeldt. 8vo. Pp. 461–493. Washington, 1894.

Dr. Shufeldt is always interesting, and every one of his numerous papers possesses the value which independent and original views are sure to command. The Comparative Oology of North American birds is an attractive subject, far too comprehensive, in fact, to be satisfactorily dealt with in a pamphlet of only thirty octavo pages. The most prominent defect in Dr. Shufeldt's essay is that he has given his facts in so condensed a form, and in such intricate sentences, that it is often difficult to follow his arguments or even to comprehend the conclusion at which we are expected to arrive. The chief portion of the information here cited is borrowed direct from well-known sources, notably, from the writings of Messrs. Coues and Ridgway, which have long been accessible to everyone at home and abroad. Occasionally Dr. Shufeldt ventures upon statements which are certainly wide of the fact: as, for example, when he asserts that the American buzzards "never defend their eggs by direct attack." Indeed it would be easy to enumerate a number of points upon which Dr. Shufeldt's opinion should be modified by the experience of his American confrères. But there is much that is good

and accurate in his text; not that we can agree with his dictum that, "from a scientific standpoint, avian oology has accomplished much in the past," for the study of egg-shells has always appeared to us to be singularly barren of important results, however pleasurable it may be to its devotees. The biological laws, which Dr. Shufeldt formulates to explain variations in the colour of the shells of eggs, seem to us to be very unsatisfactory where they are not the exposition of self-evident truths. The fact of the matter is that Dr. Shufeldt has attempted to perform an impossibility, in compressing so large a subject into such narrow limits. That he has dealt with it at all is a matter for congratulation. Cursory and superficial as his review of American oology must be admitted to be, we feel grateful that he has endeavoured to generalise at all on this difficult theme. It is to be hoped that he may find leisure to develop his oological impressions; in which case we shall, no doubt, welcome a substantial addition to the literature of the subject at some future date.

H. A. MACPHERSON.

LINNÆUS'S "SYSTEM OF NATURE."

CAROLI LINNÆI SYSTEMA NATURÆ. Regnum Animale. Editio decima, 1758, cura Societatis Zoologicæ Germanicæ iterum edita. MDCCCXCIV. Lipsiæ sumptibus Giulielmi Engelmann, 1894. Pp. iv., 824. Price 10 marks.

As the Bible is to the theologian, so is the tenth edition of Linnæus's "Systema" to the systematic zoologist.

The foundation of all binomial nomenclature, the whole scientific naming of existing animals, dates from this tenth edition of Linnæus's "Systema." In the tenth edition for the first time, the immortal naturalist was consistent in giving two names, a genus-name and a species-name, to everything he described, and therefore the tenth edition represents the sum-total of the Linnæan labours as regards founding a definite and simplified system of labelling organic nature.

For many years, and chiefly at the instance of the Committee formed by the British Association in 1842, the twelfth edition of the "Systema" was taken as the base-line, but the tenth is slowly replacing the twelfth in this country,—it has long done so in America,—and this replacement smooths over not a few difficulties that exist from works published between the dates of the two editions (1758 and 1766).

The original edition is now so scarce as to command a high price, and the thanks of all students of zoology are due to the German Zoological Society, and to Mr. Engelmann, for the publication of this reprint, at a price which brings it within easy reach of anyone who takes the smallest interest in his subject. We specially recommend it to the notice of all museum curators and librarians.

SEX.

UEBER DAS VERHÄLTNISS DES MANNLICHEN UND WEIBLICHEN GESCHLECHTS IN DER NATUR. By Dr. Georg Klebs, Professor of Botany in Basel. Pp. 30. Jena: Gustaf Fischer, 1894. Price m. 0·80.

THIS little pamphlet does not call for much comment. It was delivered as the Rectorial Address in the University of Basel last autumn, and for publication, says the author, has been altered and enlarged in a few points. It forms a readable and quite uncontroversial account of the general phenomena of sex in the animal and vegetable kingdoms. The language is simple, and—rare occurrence

in modern scientific pamphlets—the references to all the writers mentioned are pleasant and appreciative. Starting with the discovery, in August, 1677, of spermatozoa by Leeuwenhoek's pupil, Hamm, the writer traces the gradual advances in knowledge which have led to our modern conception of the sexual cells in animals and plants. He shows the general parallelism existing between animals and plants in respect both of the sexual cells and of the male and female organisms containing them. He shows how, in both, the male cells become adapted to reach the usually larger and more passive female cells, and how the sexual characters of the male and female organisms are adapted in association with these diverging capacities. He touches lightly upon the determination of sex, the influence of crossing, and of in-and-in breeding and kindred topics. We recommend this book readily—not to biological specialists, who would find in it nothing very new, but to anyone who wishes an agreeable and instructive hour's reading.

Biological Homilies.

Biological Lectures and Addresses delivered by the late Arthur Milnes Marshall. Edited by C. F. Marshall. 8vo. Pp. viii. and 363. London: David Nutt, 1894. Price 6s.

"Homilies," says the Judicious Hooker, "are plain and popular instructions." Justly, then, may we apply this term to the essays comprised in the present volume. The exposition of the advanced teachings of modern biology in language that shall be lucid yet not misleading, intelligible yet not inaccurate, increases in difficulty with the increase and extension of knowledge itself. Along whatever path of zoological specialisation we proceed, we are speedily confronted by a bristling array of technical terms, erected as necessary waymarks for the pioneers themselves, but presenting a well-nigh impenetrable barrier to their merely curious followers, while they are also unintelligible to their fellow workers on other paths. We, who month by month endeavour to lay the results of special research in an intelligible form before our readers, well understand the difficulties of such a task, and readily appreciate how successfully they have been overcome by the enthusiastic biologist whose loss we still so deeply mourn.

Most of the lectures contained in this book are reprinted from the *Transactions of the Manchester Microscopical Society* or from other publications. Five, however, are now printed for the first time from such manuscripts as were left in a fit state. These five were mostly delivered thirteen years ago, and include "The Modern Study of Zoology," "The Influence of Environment on the Structure and Habits of Animals," "Embryology as an Aid to Anatomy," "The Theory of Change of Function," and "Butterflies." The remainder deal chiefly with Cell-division, the theories of Weismann, experimental Embryology, and above all with the Recapitulation Theory, which indeed is a regular King Charles's head.

The merit of these addresses is to be found rather in their clear and vivid style than in any great originality of idea. Perhaps the earlier pages have occasionally too strong a platform flavour, which the author himself would probably have edited out. In other respects the volume contains admirable models for the populariser of biology, refreshing reading for the amateur scientist, and reliable synopses for those whose special studies have not left them time to follow the intricacies of other branches than their own.

THE BRACHIOPODIST'S VADE-MECUM.

AN INTRODUCTION TO THE STUDY OF THE BRACHIOPODA, intended as a Handbook for the use of Students. By James Hall, assisted by John M. Clarke. The First Part, issued in *Report of the Regents of the N.Y. State Museum*, xlv., for 1891, pp. 450-616. Albany, dated 1892, but published in 1894.

IN our first volume (pp. 628–629) we noticed the important work by Messrs. Hall and Clarke, entitled "An Introduction to the Study of the Genera of Palæozoic Brachiopoda." The present handbook is practically an attempt to bring the facts and conclusions of that advanced treatise into a form more suited to the pecuniary and intellectual capabilities of the student. Hitherto English-speaking students have either had to struggle with the ponderous tomes of Davidson, issued by the Palæontographical Society, or, if they wished for some more concise, elementary, and, at the same time, up-to-date account, they have had to overcome the difficulties presented by a foreign language, and to rely on the admirable summaries by Von Zittel in German, and by Oehlert in French. Although, therefore, Professor Hall tells us that "the work has been prepared for the use of American students," we take upon ourselves to assure him that, so soon as it is issued in completed book form, it will win the gratitude of all those English-speaking zoologists and geologists who share with the authors an interest in the Brachiopoda.

The present part begins with a general account of the group, which follows in the main the lucid model furnished by Oehlert in Fischer's Manuel de Conchyliologie, differing therefrom by the incorporation of the fresh knowledge acquired during the last seven years. After a synopsis of the habits of the Brachiopoda and of their bathymetric and geographical distribution, the latter illustrated by a detailed map, there follows a full description of the shell with its external and internal markings. A closer attention to the facts of growth has recently led zoologists to distinguish between the various methods in which the passage for the stalk or peduncle has become more or less closed by shelly matter or stereom in different genera of Brachiopoda. Those who wish to learn the meanings of the terms *delthyrium*, *deltidium*, *deltidial plates*, *chilidium*, *listrium*, and *syrinx*, will here, and here only, find them fully explained. Next to this comes a clear and succinct account of the anatomy of the soft parts of the animal and of those internal skeletal structures connected with the so-called "arms" or lophophore that are of such importance in classification but so hard to investigate and comprehend. We find herein full use made of the recent researches of Joubin, Oehlert, Beecher, and others, of which accounts have from time to time been given in NATURAL SCIENCE, while, in the description of the development, ample notice is taken of the growth of the shell as well as of that of the soft parts, and it is recognised that developmental change does not cease at the close of embryonic life, but continues through the brephic, neanic, and succeeding stages.

With the way thus cleared for him, the student passes next to the study of all the genera, both recent and fossil, beginning, of course, with the Inarticulate Brachiopods, and then advancing through the Orthoid, Strophomenoid, and Productoid groups of the Articulata. The order that is followed in the descriptions of the genera is precisely the same as that of the larger "Introduction" to which we have already referred. The only differences appear to be the admission of Beecher's *Paterina*, which for some reason was excluded

from the previous work, and of Matthew's *Trematobolus*, which dates from 1893. This part of the work is illustrated by numerous woodcuts; at the same time it will undoubtedly be necessary for those who wish to gain a clear idea of the various genera, now so minutely divided, to refer to the excellent plates of the larger work, and better still to such specimens as they may be fortunate enough to find showing the details of deltidial, muscular, and brachidial structure, which specimens, we need hardly say, are rarely to be found even in our best appointed museums. Owing to the great difficulty of determining from ordinary specimens to which of these revised genera a species should be referred, we cannot help regretting that the authors have limited themselves under each genus to instancing merely the type species, which of course is not necessarily a typical or common species, instead of giving a list of the chief American and European species that they would refer to the genus in question. We may add, also, that considerable use of the larger work has brought to light a defect, which is naturally intensified in this smaller book, namely, a want of clearness and definiteness in pointing out the characters that separate one genus from another closely allied to it. It is, for instance, very difficult, in many cases, to know whether to refer a species to *Rafinesquina*, *Strophеodonta*, or *Orthothetes*. The diagnostic characters are no doubt given, but they are mixed up with other characters not strictly diagnostic. This defect might easily be remedied by giving a key, like that published a short time ago by Mr. C. Schuchert, and we trust that some such step will be taken in the second part of the present book.

As in their previous work, the authors do not divide their genera into families, a course which may be warranted by the insufficiency of our knowledge, but which hardly commends itself to the text-book compiler, the museum curator, or the examinee. We all admit that our classifications probably do not tally with nature; but even a bad classification is better than none. The authors, however, promise to discuss the question of classification at the close of the work, and meanwhile we may refer to the very workable classifications by Schuchert (*American Geologist*, xi., p. 141, and xiii., p. 102). We are more inclined to quarrel with our authors for the arrangement that they have in some instances adopted. They need not commit themselves to a cast-iron classification, but surely they might follow an arrangement more in accordance with the facts of geological history and individual development. They appear to accept the main arguments of Beecher, but for some unexplained reason they do not admit the natural conclusions. Thus, they begin with the somewhat advanced Lingulidæ, then proceed through the Lingulellidæ and *Lingulasma* to the Trimerellidæ, from which they come back to the Obolidæ, and so to *Paterina*. Now if they accept Beecher's views on development, they should also accept his conclusion that *Paterina* is the most primitive form of Brachiopod known to us, and they should lead off with that genus. But perhaps this will be explained in their final chapter. Anyhow we know exactly what Messrs. Hall and Clarke themselves think about the Trimerellidæ, and we know that they derive this assemblage from two distinct stocks, one typified by *Lingulasma* and the other by *Obolus*, a view which may be correct, but which is at any rate incompatible with the peculiar arrangement they adopt. This, however, will not render their book of less practical use to the student, who will look forward with much anxiety to the second part, which we are promised in the Annual Report of the State Geologist for 1893, and which we may, therefore, expect to receive somewhere in 1895 or 1896.

When the work is complete it is sincerely to be hoped that it will be bound up together and placed on the open market.

F. A. B.

ANOTHER TEXT-BOOK OF ZOOLOGY.

LEHRBUCH DER ZOOLOGIE FUR STUDIRENDE UND LEHRER. By Dr. J. E. V. Boas. Lector der Zoologie an der Kgl. Landw. Hochscule Kopenhagen. Pp. 503, 427 illustrations. Second and enlarged edition. Jena: Gustaf Fischer, 1894. Price 10 marks.

IN the increasing multitude of foreign and English text-books, it is not always easy to see any but local pretext for the issue of the books. It is natural and right that where a teacher is honoured in the country in which he teaches, his students should have his written as well as his spoken word. This text-book is written specially for medical students, students of veterinary science, and so forth. Those of us who have taught or examined similar students in England will wonder with a great admiration at the range and thoroughness of the course of zoology mapped out for these in Copenhagen. In a general part of eighty-eight pages Dr. Boas gives an account of the animal body on the old Hunterian plan of division into tissues and systems. Then he treats rapidly but briefly the special problem of Morphology, the plans on which animal organisms are built, the embryological growth of organisms, and the relations of the diverging types of adult structure to each other. Next he treats of various biological problems, such as the influence of sessile life, the duration of life, adaptations, the relations of animals to their environment, and so forth. All this is as simply and as philosophically done as we have seen in any book, and Dr. Boas's students are to be congratulated on their teacher. The systematic part is equally well written. In invertebrates the most typical or the best known species only are referred to. In vertebrates the enumeration of species is carried out much more fully.

The illustrations are all good. There are many old friends and many desirable additions. Altogether we have nothing but praise for this text-book. While it is not conspicuously better than the other leading books of the same kind, it is thoroughly satisfactory for its purpose, and much better than any English text-book or translation.

A GEOLOGICAL TEXT-BOOK.

GEOLOGY. A Manual for Students in Advanced Classes and for General Readers. By Charles Bird, B.A. Lond., F.G.S. 8vo. Pp. 429. London: Longmans, 1894. Price 4s. 6d.

THE illustrations constitute the feature in which this book differs most markedly from most works of the kind. These fall into three groups. First, and most important, a new set processed from photographs, some from those by Messrs. Wilson, chiefly of coast scenery, mountains, rivers, and old volcanic tracts, which are admirable in selection and in method of reproduction; the rest, of rocks, minerals, and fossils in the Jermyn Street Museum, often of figured or type-specimens, among which special attention should be given to figs. 145, 214, 231, and 237; both of these sets of illustrations are excellent and will give more than a passing value to the pages they adorn. Secondly, there are illustrations, for the most part good ones, borrowed from earlier works, some with adequate acknowledgment, as in the case of those from the works of Green and Bauerman, others without, like figs. 170, 211, 239, 259, 261, 287, which appeared first in Woodward's "Geology of England and Wales." Thirdly, those which have been recovered from some forgotten talus heap, or

else specially drawn for the work, as we do not recollect having seen them before, and fervently desire never to see them again. For example, the drawing of the quartz crystals on page 13 is preposterous, of hornblende on page 30 useless, while the fancy glacier on page 115 has no excuse, when good photographs, which might really teach something, are so easily obtainable. Why should a ridiculous and imaginary creature be made to masquerade as a trilobite on page 194, when a very good figure of *Ogygia Buchii* is wasting away in the uncongenial air of the Cambrian a few pages further on? Impossible graptolites, undesirable plesiosaurs, and shells and sponges standing on their heads should not have been tolerated amongst the other illustrations, and more satisfactory photographs or drawings of some of the rock-specimens should have been secured. It is tantalising not to be told where a conformable sequence from Carboniferous to Keuper is to be found (p. 273), or where the Lias rests direct in the Permian conformably and unconformably within a short distance, while the Oolite is unconformable to the Lias (p. 284).

Leaving these and other errors in the illustrations and turning to the text, it is clear that this has suffered by being cast in the rigid mould of a South Kensington Syllabus, so that an attempt has to be made to put into the book far more than can be *taught*, though it may possibly be *crammed*, in a work of this size. What is the use of attempting to teach anything about systematic crystallography without at least a drawing to show the relations between crystal axes and faces, or to simply state, without any explanation, that a crystal has or has not an effect on polarised light, unless these statements are merely intended to be committed to memory? The petrology is worse than the mineralogy; after learning that mere disintegration will convert granite into "gravel," that phonolite is "acidic," syenite basic, felsite and pitchstone plutonic, we are not much surprised to hear that the last class of rocks is often amygdaloidal. Slips and misprints abound: Marlsto, Brokenhurst, labrodorite, *Hippurites ponderosum*, Flanborough, Coraline, kim-clay, *Unio* (p. 320), Landeilo, Geographical Survey, *equivalvus*, while some of the definitions, doubtless accurate, do not help very much in understanding the application of words, like asbestos, unquenchable, and eggstone for roestone.

The latter part of the book is rather better done, the physical part decidedly so, and among the good features are vertical sections of the systems, showing their characters, fossils, and economic products. There are disfigurements, however, here and there. We read of trilobites with only two segments, that there is a Rhætic fish still living, that the "characteristic ammonites occasionally show a tendency to become a little mixed," and that belemnites are the "internal shells of a kind of cuttlefish." It is a pity the author has not cleared things up for the student by adopting the tripartite division of the older Palæozoic rocks now everywhere adopted, and that he has omitted all reference to the Ordovician and Silurian rocks of the Lake country, while giving a careful description of the foreign equivalents. Scant space is devoted to modern theories and views in the origin of the foliated rocks, and the minute zoning of the Upper Cretaceous rocks has been omitted.

In conclusion, while the author has introduced some important and novel features into his book, he would do well to prevail on his publishers to make a bonfire of certain venerable illustrations and to let the proof sheets of a new edition pass under the eyes of those who are familiar by actual field work with their several branches of the

science, in order to eliminate errors and supply omissions in a subject too wide to be adequately covered by a single individual, however varied his attainments.

THE LOWER OOLITES IN ENGLAND.

THE JURASSIC ROCKS OF BRITAIN. Vol. iv. Lower Oolitic Rocks of England (Yorkshire excepted), by H. B. Woodward, F.G.S. 8vo. Pp. xiv., 628, with plates i., ii., and woodcuts. Memoirs of the Geological Survey of the United Kingdom. London: Printed for Her Majesty's Stationery Office, 1894. Price 10s.

THIS is the companion volume to the one reviewed in NATURAL SCIENCE, vol. iv., p. 69, and it is by the same author. Whether the strictures then passed on the "get-up" of the volume have led to improvement, we will not presume to say; at any rate, the present volume shows a pleasing contrast to the earlier one, though it is still much below the standard befitting such a publication. The volume deals with the Lower Oolitic rocks of England, Yorkshire being excepted. Such a division of the geographical extent of the Lower Oolite may be convenient; but it seems to give undue prominence to Yorkshire, and to throw an unfair burden on the author of the present treatise. It is an immense, and, if we may say so, too ambitious a task for one man to cover so much ground. Such a proceeding may indeed possess the advantage that if the author be a strict palæontologist his readers know that, by whatever names he alludes to species, the same form receives the same name in different districts. This is, of course, not the case with different observers, and hence much of the difficulty of geological correlation results. Unfortunately, even this advantage is thrown away in the present instance. The weakest part of the whole work is the palæontology, not because of any want of ability on the part of those responsible for it, but because they cannot bring themselves to appreciate the needs of modern work. At the same time, the wisdom of expecting two or three men to grapple with all the present intricacies of palæontology, until separate monographs placing the subject in available form have been prepared, may well be doubted. In consequence of this policy the result is, as the Director-General says in a somewhat apologetic preface, "A general memoir which is intended to present a broad but detailed picture." We have no fault to find with this intention; but the detail should be accurate.

The scope of the volume is from the zone of *Ammonites jurensis* to the Cornbrash. The zone of *A. jurensis* was treated in the companion volume of the Lias. It is here included to form, with the *A. opalinus*-zone, a division, "Midford Sand," which is parted between the Lias and the Inferior Oolite—the term Midford Sand being qualified by the words "Yeovil" or "Cotteswold," according to locality, a concession which will be understood by those acquainted with the strata and with recent literature. Besides the zone of *A. opalinus*, only three other zones are admitted in the Inferior Oolite. The labour of further subdivision has been shirked, under the plea that other zones are only local—a curious plea, when some of those not admitted were traced across Europe thirty and forty years ago.

The whole of what is called "Great Oolite Series"—from Fuller's Earth to the Cornbrash—is divided into two zones, of which the Cornbrash takes one, that of *Ammonites macrocephalus*. Something seems to require explanation here. *A. macrocephalus* has usually been

regarded as indicating the zone above the Cornbrash. The author puts it (in the Appendix) as a fossil which ranges above the Cornbrash; and this admission seems to call in question the wisdom of the division adopted—a division not accepted by Continental authors. At the same time, it excites a doubt whether *A. macrocephalus* belongs to the Cornbrash, or whether the Cornbrash may not be only a lithological series of different palæontological age in different districts. We are inclined to ask, "What is Cornbrash?", well aware that every geological student preparing for his first examination would think himself able to instruct us.

In the "Great Oolite Series" we are introduced to a new term, "Fullonian," an impossible word from *fullonius*, which we hope will not be adopted. Only one Ammonite zone comprises the "Fullonian," and the greater part of the Bathonian. This is an extraordinary inversion of the value of terms, and it shows where work is required in this country. It also forcibly illustrates the lithological tendencies of the author. He can appreciate and recognise subdivisions where they are based on lithological characters, because these are so striking and catch the eye so readily that it would be impossible for anyone to overlook them. When, however, it comes to the more difficult task of looking beneath the surface, and understanding divisions made upon palæontological grounds, the author shows himself unable to perform it. Although the volume does not profess "to enter into minute particulars [which] belong to the domain of the specialist in some restricted field of palæontological research," yet it does enter into such particulars where lithology is concerned. Thus, as lithologist, the author is able to recognise eleven subdivisions of the Inferior Oolite; as palæontologist he can only see four. In our opinion, the volume marks the specialisation of the lithologist, and though we do not find fault with it on that account, for that is where its value lies as a scientific work, yet we take exception to the unequal treatment accorded to palæontology.

Perhaps the incorrectness of the palæontology is best exemplified in the woodcuts which illustrate the work. We confess to a difficulty in understanding why the woodcuts are given, because if the general geologist can identify his specimens therefrom he possesses skill denied to any specialist. Even if he do succeed he is no better off, for he will be wofully misled as to names. Why, when the original types were figured in British works, and when many of them are accessible in the British Museum, the woodcuts of what purport to be the same species should have been prepared from foreign figures, we are unable to understand. The result is certainly disastrous. Page 46 shows woodcuts of *Ammonites sowerbyi*, *A. murchisonæ*, and *A. humphriesianus*, all after d'Orbigny, whereas these fossils were named and figured by Sowerby. But d'Orbigny's *A. sowerbyi* disagrees in many respects with the type. His *A. murchisonæ* is not admitted to be that species at all, and his *A. humphriesianus* was named as a different species forty years ago by Oppel. Again, p. 48 shows a woodcut of *A. parkinsoni* after d'Orbigny, where a copy of Sowerby's type-figure might just as well have been given, and it would have saved the author the mistake of depicting as *A. parkinsoni* what has been separated by another name for some years. Worse, however, remains than this. Among the "Cornbrash fossils" shown in page 432, fig. 119 gives *Ammonites discus*, after d'Orbigny. This is another of Sowerby's species and the type is from the Cornbrash; but d'Orbigny figured as his fossil an Inferior Oolite shell. With unfortunate

temerity the author has taken upon himself to say that the Inferior Oolite species figured by d'Orbigny under a wrong identification is a Cornbrash fossil, and he has called it "*Ammonites discus*, Sowerby." A comparison of the suture lines shown by d'Orbigny and indicated by Sowerby ought to have put him on his guard. We fear, however, that such little details as suture lines do not accord with "individual views about species"—a phrase we find more than once in this work.

In the catalogue of fossils given in the appendix palæontological inaccuracy also reveals itself. It is not, however, by any means so conspicuous as was the case in the Liassic volume, and this, we take it, results from detailed work on Lower Oolitic species having been done by specialists in various recent publications. Thus the greatest and therefore most suspicious zonal ranges to be found in the tables are shown among the Lamellibranchiata, with which no British specialist has yet engaged himself, and we confidently expect that when one does these zonal ranges will be very much restricted. Outside the Lamellibranchiata very few species are given with wide zonal range—a marked contrast to the Liassic volume, while the majority are recorded from a single zone. A few exceptions occur, noticeably among the Brachiopoda. Thus *Rhynchonella concinna* and *R. obsoleta*, *Waldheimia anglica*, and *W. bullata* are given wide ranges. We venture to say that those who are making a study of Jurassic Brachiopoda—a by no means small band of naturalists in the West of England—will be unable to endorse these "finds" of the author. Nor will they wish to take from the Survey the credit of recording *Rhynchonella ringens* in the *Parkinsoni*-zone. We can understand some of the other zonal records by ascribing them to "individual views about species," but we confess to being entirely at a loss to know what *Rhynchonella* of the *Parkinsoni*-zone can have been mistaken for *R. ringens*, a species so remarkably distinctive in every way.

The stratigraphical work is also not free from error. Thus, in the section of Leckhampton Hill (p. 124), a considerable series of sandy beds, which should be between the Gryphite and lower *Trigonia* grits, are not shown at all. On page 110 something seems to have gone amiss with the zonal arrangement; for, while in the early part of the volume (p. 45) "the zone of *Humphriesianus*" is placed in the "upper division," here it is put to overlap a portion of the "lower division." Then the upper *Trigonia* grit is left out of account for zonal purposes altogether. The recognition of the zone of *A. humphriesianus* at all in the Cotteswolds may be regarded as an error founded on misconceptions of Wright and Witchell, and in making a quotation to support it (p. 111) about there being "no break of a marked character between the upper *Trigonia*-grit and the Gryphite grit," the author has done a little special pleading: the context insisted on there being a chronological break.

Although we have thus pointed out some of the pitfalls which have entrapped him, we hasten to place on record our conviction that, considering the immensity of the task upon which he has been engaged, the author has produced a work of great value to all those who may be studying the Lower Oolitic rocks. As a record of what has been done among these strata, accompanied by many new and important contributions from the author himself, as a guide to the localities and the rocks which they exhibit, and as a starting point for all new work, the volume is one of great interest. Our thanks are due to Mr. H. B. Woodward for the amount of information which he has rendered so readily accessible to the student.

Fossil Plants.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History). The Wealden Flora. Part I.—Thallophyta–Pteridophyta. By A. C. Seward, M.A., F.G.S. Pp. xl., 179, with 17 woodcuts in the text. Plates i.–xi. London, 1894. Printed by order of the Trustees.

This, like some other British Museum Catalogues, is not a mere list but a detailed description of the specimens, with numerous critical remarks on their systematic position, and a discussion of the present state of our knowledge of individual groups. In an introduction of some five-and-twenty pages, the author summarises the results of previous work on the Wealden flora, and gives an account of records of fossil plants from other countries, but of presumably the same or similar age. Some recent collections of Mr. P. Rufford from the neighbourhood of Hastings have supplied much of the material for the present volume, but reference is also made to the collections of Mantell, Dawson, and Beckles. Three genera and twelve new species are instituted.

While commending the thoroughness of the work, and the care with which facts previously known are considered in the light of fresh knowledge, we would at the same time draw attention to one or two points affecting mainly the principle of the book or its arrangement. Thus, while it is of the utmost importance to quote synonymy, it is well also to avoid such a waste of space as is entailed by the chronological arrangement which has been adopted. For instance, under *Weichselia Mantelli*, we have an account of the annual variation in the naming, from 1825 to 1890, occupying nearly two pages (pp. 114–16), in which one synonym, *Lonchopteris Mantelli*, occurs fourteen times. Surely it would have been better to lump all the references to this name in one paragraph. Similarly, on p. 27, under *Equisetites Burchardti*, this name occurs a dozen times. And why are we made to seek in the obscurity of the text for references to the plates?

The description of individual specimens is, we think, sometimes carried to an excess. For instance, under the species just mentioned, we find entries such as these:

V. 1070 and V. 1070a. A short piece of stem with three tubers, and another piece with four.

V. 1070b. Fragments of stems and several tubers. Two tubers shown in contact.

V. 2818 and V. 2819. Fragment of the same species.

As each item means a paragraph, no little space is thus occupied, whereas a bare quotation of the register numbers would have served the purpose.

A far more important point, and one affecting a great deal of recent palæontological work, is the foundation of species on material, the insufficiency of which the botanist shudders to contemplate. To give one instance: *Equisetites Yokoyamæ*, sp. nov., is founded on some tubers and fragments of stems, the tubers differing from a species previously described "in their smaller size and narrower elliptical form." It is well to note such differences, but to erect a new species without the support of other evidence, save locality, is to prejudice the undoubted value of the work as a whole. By the description of new species from often badly defined fragments of fronds, or other vegetative organs, specific names are reduced to marks of identification of individual specimens, and a comparison of facts in recent and fossil botany is rendered extremely laborious or practically impossible.

METEOROLOGY IN MARYLAND.

THE CLIMATOLOGY AND PHYSICAL FEATURES OF MARYLAND. First Biennial Report of the Maryland State Weather Service. Director, William Bullock Clark. 8vo. Pp. 140, 5 folding maps. Baltimore, 1893.

IN our February number (vol. iv., p. 146) we reviewed an Outline of the Geology and Physical Features of Maryland, which, it will be remembered, contained much information as to the climate of the State. In the present Report the various meteorological data are given in much more detail, with careful analyses of the weather in different parts of the State during the years 1892 and 1893, and with tables showing the daily rainfall at 27 stations. The agricultural and practical value of this portion is greatly enhanced by a detailed account of the state of the various crops as dependent on the changing weather during the period in question. The general interest of the work, however, lies in the relations which it establishes between the leading features of the climate and the topography, and therefore also the geology, of the State. There is naturally a great difference between the western part of the State, or Appalachian region, and the lower lying Piedmont Plateau and Coastal Plain (see our previous review). Thus the average annual temperature of the extreme western region is 50° Fahr., that of the eastern border 58°, while even more pronounced variations are seen when the comparison is made by seasons. Similarly the average yearly rainfall of western Maryland is about 38·5 inches, while that of the remainder of the State is nearly 44 inches. A more detailed comparison brings out still more interesting facts. The lie of the isotherms, for instance, both annual and seasonal, is directly traceable to the configuration of the country. Variations of rainfall too can, as a rule, be explained by similar reasons. "Thus the broad Frederick Valley, lying as it does on the eastern flank of the Blue Ridge, receives an abundant rainfall from the moist south-easterly winds." At the same time there are many striking local variations in precipitation that have not yet received their explanation, and Professor Clark believes that they cannot be due to topographic differences.

Of the value of this work, which has only been in progress since May, 1891, we cannot speak too highly, and we are the more inclined to give good words since so much of the labour is voluntary. It is not merely to the Maryland farmers that these reports will prove of service: their educational value for schools, as showing in a comprehensible manner so many natural sequences of cause and effect, is not to be exaggerated; while we have no doubt that their usefulness to foreign meteorologists as records of fact will fully rival the services they will render to the State itself by attracting immigrants to a country so highly favoured of the clerk of the weather.

CONGRÈS GÉOLOGIQUE INTERNATIONAL. Compte Rendu de la 5me Session, Washington, 1891. 8vo. Pp. x., 530, maps and illustrations. Washington: Imprimerie du Gouvernement, 1893.

THIS ponderous volume of the proceedings of the fifth Geological Congress, held at Washington in 1891, reached England on the 23rd June. It contains reports of the various discussions on Pleistocene and other strata, the colouring of geological maps, the international bibliography of geology (which is in the press, and will be distributed by the author, M. de Margerie, as soon as ready), and a full report of

the excursions made by the Congress, dealing somewhat extensively with the geology of the western United States. The excursions, three in number, comprised the following: (*a*) The neighbourhood of Washington; (*b*) the Rocky Mountains; (*c*) Lake Superior, and the reports occupy some 330 pages. Maps, sections, and illustrations are given in quantity, as well as a sketch of the literature of each district, and the volume thus possesses the usual permanent value of these reports. It is a pity, however, that so long a time has lapsed before publication.

The Journal of Marine Zoology and Microscopy (May, 1894) continues to grow apace both in size and interest. This new number contains papers on "Sexual Colouring in the Cuckoo Wrasse," "The Significance of Dual Opercula in Serpulids," "Abnormal Muscular Bands in Salpa," as well as descriptions of the beautiful microscopical preparations sent out to the subscribers. The slides sent out this time contain the Phyllosome stage of *Scyllarus*, and four sections illustrative of the structure of the Anemones. That the Jersey Biological Station is progressing is only what we should expect, the situation being especially advantageous for the collection of marine objects. That it has many friends is evident by the ready response that has been made to a request for donations to the Library. We heartily wish Messrs. Sinel and Hornell the success they deserve.

Mr. G. S. Perrin sends us a reprint of a paper on Australian Timbers, read before the Royal Victorian Institute of Architects. The species of *Eucalyptus* supply the greater number of the useful woods, one of the commonest and best being the Blue Gum (*E. globulus*). The Hum or Macquarie Harbour Pine (*Dacrydium Franklinii*) is said to take precedence of all Tasmanian timber for lasting qualities, beauty, and easiness of working, while Western Australia has a large source of wealth in her immense *jawah* forests (*Eucalyptus marginata*). The author lays stress on the great importance of a rational conservation of forests, suggesting that when the reckless waste in America has caused a serious shortening of the timber export from that country, Australia will be looked to to supply the deficiency.

The Jura of extra-European countries is receiving attention. The *Zeitschrift der Deutschen Geologischen Gesellschaft*, Bd. xlvi., Heft. 1, contains a paper by Dr. K. Futterer on the Jura of East Africa, with six plates chiefly devoted to the illustration of Ammonites. The fossils obtained from Mombassa, Tanga, etc., are considered to indicate beds of Callovian, Oxfordian, Kimeridgian and Tithonian age.

Mr. J. T. Cunningham has two interesting papers in the last number of the journal of the Marine Biological Association. The first, on "The Life History of the Pilchard," traces the development of this fish from the egg until nine days old, when the observations were stopped by the death of all the specimens. The second paper deals with the ovaries of fishes, and refers to those of the plaice, dab, flounder, sole, turbot, and brill.

From Mr. David Nutt we have received Schröter's "Coloured Vade-mecum to the Alpine Flora," fourth edition, price 7s. This is a handy guide to alpine flowers, and will be of considerable service

to tourists in enabling them to identify their specimens. The serious student will not, of course, forget his Gremli, so indispensable to minuter study.

MM. J. B. BAILLIÈRE ET FILS, 19 Rue Hautefeuille, Paris, write to tell us that they have nearly ready for publication a Bibliography of French Flora, containing the titles of nearly one thousand books and pamphlets dealing with the subject. These are classified according to geographical regions. The publishers will send it free to anyone writing for it.

THE *Nuovo Giornale Botanico Italiano* commences a new series with the present year. The original publication, which dates from 1869, was edited till 1872 by Beccari, but for the last two-and-twenty years has appeared under the direction of Professor T. Carnel. Henceforth it becomes the special organ of the Italian Botanical Society, and will contain those papers which are too large for publication in the Society's Bulletin. This is indicated by the addition to the title, "Nuova Serie," "Memorie della Società botanica italiana."

UNDER the title of "The Land of Viti," Mr. J. P. Thomson's paper on the Fiji Islands, read before the Adelaide Meeting of the Australian Association for the Advancement of Science (September, 1893), has been printed in the *Scottish Geographical Magazine* for March. Mr. Thomson deals with the various geographical divisions of the group, the coral reefs, geology, products, fauna, flora, natives, and climate. The paper is long and interesting.

WE have received from Messrs. Williams and Norgate the issue of their foreign book circular for June, 1894, being no. 59 of their Scientific Series. It contains a classified list of recent foreign scientific publications, with the net cash price for which they can supply each book. Purchasers of scientific books will find it very convenient.

THE July number of the *Scottish Geographical Magazine* contains articles and news of considerable interest and value. Dr. Otto Pettersson continues the account of recent Swedish hydrographical research in the Baltic and North Seas. In the last number of NATURAL SCIENCE, vol. v., pp. 5–7, we gave an account of the first part of Dr. Pettersson's review. This new part contains much detailed information, and is illustrated by many valuable charts of the degrees of salinity, the direction of currents, the contours of the sea-bottom, etc., of the areas investigated. Mr. E. Delmar Morgan writes of the mountain systems of Central Asia, and a useful coloured map is annexed. Mr. D. R. Urquhart continues his interesting notes upon the Bolivian *Altiplanicie*.

OBITUARY.

BRIAN HOUGHTON HODGSON.

BORN 1800. DIED MAY 23, 1894.

MORE than a third of a century has passed away and a new generation has arisen since the last contribution to Natural History from Brian Hodgson's pen was originally published, and it is more than half a century since he ceased to take an active part, as an official, in the work of the Indian Government. To appreciate the services that he rendered to Natural Science in the first half of the present century, it is necessary to recall the change, both in our knowledge of India and in our means of communication with it, that has taken place in the interval. One instance will suffice. At the time when Mr. Hodgson investigated the religions and languages, and described the mammals and birds of Nepal, so little was known of the Himalayas that their peaks, which exceed by many thousands of feet all other mountains on the earth, were supposed to be inferior in elevation to those of the Andes.

A few words will be sufficient for a sketch of Mr. Hodgson's career. He was the son of a banker, and was born at Macclesfield; he entered Haileybury in 1816, and landed in Calcutta to join the Indian Civil Service in 1818. In 1820 he was appointed secretary to the Resident at Katmandu, in Nepal; he became Resident in 1831, and occupied the post till 1843, when he was replaced by an even better known Indian official, afterwards Sir Henry Lawrence. Mr. Hodgson resigned the Indian service, and for a time returned to Europe, but in 1845 he took up his residence at Darjiling, a hill station that had only been occupied for about five years, and he remained there, partly engaged in studying the birds and mammals, but chiefly occupied with linguistic enquiries, until he finally left India in 1858. After his return to England he entirely relinquished the scientific pursuits on which his widespread reputation was founded.

There is no richer mammal and bird fauna in the world than that of the Eastern Himalayas, and if, when Mr. Hodgson arrived in Nepal, he entered on a zoological Eldorado, he made superb use of the opportunities he enjoyed. For many years the *Asiatic Researches* and the *Journal of the Asiatic Society* were filled with descriptions of new birds and new mammals from his fertile pen, and many of his communications appeared in the *Proceedings of the Zoological Society*

and in other periodicals. His papers, as a rule, were far from being mere descriptions of new forms; they contained numerous notes on anatomy, affinities, and habits. He published no large work, although for many years he proposed to bring out an account of the Nepalese bird and mammal fauna, with coloured illustrations. A large number of coloured drawings that had been prepared for this work by native artists under his direction were presented by Mr. Hodgson, together with the types described by him and the bulk of his collections, to the British Museum. In addition to these, he presented numerous specimens to the Museums of Calcutta, Paris, Leyden, Edinburgh, Dublin, etc. As a collector, indeed, he was at the time unrivalled. In the "List of the Specimens of Mammalia in the Collection of the British Museum," published in 1843, Mr. Hodgson's name is attached, in the "Index of Donations," to a larger number of references than any other donor's, and at this time only his first contribution to the national collection had been received. Subsequently, two separate catalogues of his presented collections were published, one in 1846, and the other in 1863.

A better idea of Mr. Hodgson's energy than any that can be derived from lists of specimens or even from a perusal of his papers is afforded by the drawings presented by him to the British Museum, or, still better, by the original copies that have found an appropriate resting-place in the Library of the Zoological Society of London. These drawings represent many hundreds of mammals and birds, and fill several large folio volumes, the same species being sometimes drawn three or four times. Each sheet, besides the figure of the whole animal, generally contains drawings of details of the external and internal structure, and the paper is crowded with manuscript notes on the localities, habits of life, breeding, nidification, and measurements. No better example of the care with which Mr. Hodgson collected facts could be cited than his paper "On Various Genera of Ruminants," published in 1847 (*J.A.S.B.*, xvi., p. 685). In some respects he was in advance of the science of the day. He was fully alive to the importance of geographical distribution, and was the first to attempt a demarcation of the zones of life, resulting from differences of elevation, in the Himalayas. Unfortunately, his collections, when incorporated with those of the British and other Museums, were indiscriminately labelled Nepal, whether they came from that country, from Sikhim, or from the plains of India. Serious confusion has resulted from this mistake and from others of a similar kind.

Mr. Hodgson's researches in Natural History were by no means his only claim to recognition. He was even better known for his enquiries into the languages, literature, and religion of Nepal than for his study of the fauna. He has been regarded as almost the discoverer of Tibetan Buddhism, and he certainly was the first to call attention to its literature. During the years that he lived at Darjiling, in the dwelling so admirably described in Hooker's

Himalayan journals—one of the most beautiful sites to be found, even in that magnificent range—by far the greater part of his time was devoted to the collection of the unwritten languages spoken by the scattered and rapidly disappearing aboriginal tribes of India, from the Himalayas to Ceylon. Nor were his diplomatic services small; among them it may be remembered that he was the first to advocate the enrolment of Ghurka sepoys, and to appreciate the merits of one of the most gallant races of Asia.

Owing to the interest excited in Paris, then a great centre of Oriental studies, by his researches in ethnology and literature, Mr. Hodgson became, as long since as 1838, a corresponding member of the Institute, and received the Cross of the Legion of Honour and a special medal struck by the French Asiatic Society. In England the recognition of his services to science was tardy and incomplete. He became a fellow of the Royal Society in 1877, and when he was in his ninetieth year the University of Oxford conferred honour on itself by investing him with the degree of D.C.L. It is to be regretted that no place has been found for him in the long roll of honours conferred by her Majesty for services in India.

CARL JOSEPH HYRTL.

Born 1811. Died July 17, 1894.

AMONG others who have passed away recently is Carl Joseph Hyrtl, the anatomist, of Vienna. Dr. Hyrtl was almost as famous a teacher as an investigator. He aroused an extraordinary enthusiasm in his students, his classes being attended not merely by those qualifying for medical work, but by those already advanced in years and eminent in their profession. He was also celebrated for his anatomical preparations, which, scattered in all directions, bear eloquent testimony to his energy and powers. Dr. Hyrtl had a remarkable knowledge of languages, speaking Greek and Latin as well as several modern languages. He died at Perchtoldsdorf, near Vienna, where he had retired when the affliction of blindness closed his earthly labours. He is best known to the public by his "Anatomy of Man," and "Topographical Anatomy." His other works dealt with the anatomy of mammals, reptilia, and fishes.

Ferdinand Heine, the founder of the Ornithological Museum which bears his name, died on 28 March at Halberstadt; Lucien François Lethierry, the well-known student of Hemiptera, died at Lille on April 4, at the age of 64; Edward Norton, the entomologist and specialist on Hymenoptera, on April 8, at Farmington, Conn., U.S.A., at the age of 70 years; Dr. F. Quiroga y Rodriquez, Professor of Crystallography at the University of Madrid, on June 3.

Dr. Quiroga also contributed to our knowledge of the geology of the interior of Africa.

CARL THEODOR LIEBE, the geologist and ornithologist of Thuringia, passed away at Gera on June 5; and EDOUARD LEFÈVRE, the Secretary of the Société Entomologique de France, and a well-known Coleopterist, died at Paris on June 18, aged 55 years.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Dr. J. Walther has been appointed Professor of Geology and Palæontology at the University of Jena; Dr. A. Tenne, Professor of Mineralogy at the University of Berlin; Dr. F. Altmann, Professor of Botany at the University of Freiburg i.B.; Dr. A. König, Professor of Zoology at the University of Bonn; and Dr. R. Scharizer, Professor of Mineralogy at the University of Czernowitz.

Mr. P. Chalmers Mitchell, M.A., F.Z.S., lecturer in Biology at the Charing Cross Hospital Medical School, has been appointed lecturer in Biology at the London Hospital Medical College.

Mr. R. Lydekker, F.R.S., is again in the Argentine Republic. He is engaged on the further study of the palæontological riches of the La Plata Museum.

Dr. C. J. Forsyth Major, accompanied by Mr. A. Robert, starts for Madagascar at the end of this month under the auspices of the Royal Society. Dr. Major will endeavour to complete our knowledge of the extinct animals that have inhabited the island, and his special qualifications, both as a zoologist and an explorer, allow us to hope for considerable and valuable results. Dr. Major is a Scotsman, and was born in Glasgow; as now he belongs to every country, we hope he will have little trouble with any of the powers that be.

Mr. F. W. W. Howell proposes to make a third exploration of Iceland. The district to receive attention is the Northern Glacial district of the Vatna Jökull. The funds necessary Mr. Howell proposes to raise by promising a lecture on his return to any society or institution for a fee of five guineas.

Our statement that Dr. R. Semon had left the Anatomical Institute at Jena was gleaned from an erroneous source; although Drs. Braus and Drüner have become assistants at that establishment, it will not lose the valued services of Professor Semon.

The following eminent botanists have promised to attend the meeting of the British Association:—Dr. Strassburger, Dr. Zacharias, Dr. Errera, Dr. Pfeffer, and Mr. Douglas H. Campbell.

Mr. George Holt, of Liverpool, has given £5,000 to the University College of that town, which is to be invested to maintain the pathological and bacteriological laboratories. Professor Boyce, of University College, has been elected by the council to fill the newly-created post.

The generosity of Ludwig Mond, F.R.S., has placed at the disposal of the Royal Institution the freehold of No. 20 Albemarle Street, to be held for the purpose of a laboratory, to be named "The Davy-Faraday Research Laboratory of the Royal Institution." Mr. Mond further offers to make all necessary structural alterations and to equip the laboratory with apparatus, appliances, etc.

A GOVERNMENT Museum for Natural History and Ethnology has been established at Para, in North Brazil, and Dr. Emil A. Goldi has been appointed its first Director.

THE Library and Reading-Room of the Linnean Society will be closed during the month of August for cleaning.

THE Zoological Society of Dublin have received, on deposit from Mr. Cross, of Liverpool, an Orang Utang. The attendance at the Gardens during the month of May reached 11,000.

THE *Deutsche Fischerei-Verein* offers a prize of 1,000 marks for a paper embodying the best researches on the pathological and anatomical influence exerted on fish by the presence of the following substances in the waters that they inhabit:—(1) Free acids, (2) free bases, especially lime, ammonia, and soda, including the soluble carbonates of potash and soda, (3) free bleaching gases (chlorine and sulphurous acid). The determination of pathological characters accompanying the death of fish from asphyxia is also desired. As appropriate subjects the Salmonidæ and Cyprinidæ are suggested. Papers, which may be in German, French, or English, must be sent in by 1st November, 1896, to Professor Dr. Weigelt, Zimmerstrasse 90/91, Berlin, S.W., and from him further details may be obtained.

AT its meeting in Munich, the German Zoological Society drew up the final programme for the great systematic work to which we have alluded (NATURAL SCIENCE, Nov., 1893, p. 383). The work, which will be published by G. Fischer, of Jena, is to be entitled "Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen." Though excluding animals properly described as fossil, the work will take cognisance of such forms as have become extinct during historic times. Each species will be accompanied by a diagnosis, as brief and clear as possible. We are glad to find it recognised that such a work can only attempt to be a synopsis of actually published knowledge, and that no corrections or new descriptions can be admitted. The direction of this gigantic task is entrusted to Professor F. E. Schulze, of Berlin, who will be assisted by a committee of seven and a number of sub-editors.

THE Geological Society of London has raised its Composition Fee. We give the new bye-law which was passed at a special general meeting held on June 20, 1894. "A fellow may at any time compound for future annual contributions, that of the current year inclusive, by payment of thirty-five pounds, or if elected before the 1st November, 1894, by a payment of thirty-one pounds ten shillings, or if elected before the 1st November, 1877, by a payment of twenty-one pounds. If he has already paid the contribution for the current year, or any part of it, such payment shall be reckoned as forming a portion of the composition."

THE Geologists' Association of London holds its long excursion this year in Shropshire. The programme, which is elaborate and lengthy, speaks well for the energy of the leaders and the excursion secretary, Mr. Thomas Leighton. Members will have an opportunity of inspecting in the field the whole sequence of rocks below the Bunter Sandstone, and that under the leadership of such men as Lapworth, Watts, Blake, Callaway, and La Touche. The excursion lasts from July 28 till August 4. The headquarters will be Shrewsbury.

WE learn from *Science Gossip* that a Geologists' Association has been formed at Bristol, which holds meetings and makes excursions on Sundays. The honorary secretary is Mr. Frederick Ellis, 22 Senier Street, Bristol.

THE Hundred-and-tenth Meeting of the Yorkshire Naturalists' Union was held at Knaresborough, on Saturday, July 14, 1894, for the investigation of the Nidd Valley from Nidd Viaduct to Goldsborough Mill.

THE meeting of the French Association for the Advancement of Science will take place at Caen, from the 9th to the 15th August; the Geological Society of France will hold their extraordinary meeting at Lyons from the 19th to the 26th August; and the Botanical Societies of France and Switzerland at Geneva and the Valais from the 5th to the 14th August.

THE meeting of the Museums' Association at Dublin called out some interesting papers. Mr. H. B. White of the Dublin Museum described certain of the fittings and appliances there used. Mr. W. E. Hoyle, of the Manchester Museum, described some beautifully arranged cases, illustrative of the structure of the Foraminifera and the classification of the Pelecypoda; the latter explain the two different systems of arrangement according to shell-teeth and gill-structure. Messrs. Hoyle and Bolton explained an elaborate system of cataloguing fossils on a modification of Dewey's decimal method. Mr. G. H. Carpenter showed some attractive cases that he has arranged in the Dublin Museum to illustrate the chief features in the struggle for life, evolution, and geographical distribution of animals. Mr. H. O. Forbes, of Liverpool, advocated the centralisation of type-specimens in metropolitan museums, a suggestion that gave rise to a lively discussion. Mr. F. A. Bather, of the British Museum, had a great quantity of useful information, collected from museums in different distant parts of the world, which he endeavoured to impart to his colleagues. Professor T. Johnson, of Dublin, upheld the value of a Botanical Museum, especially in its relation to agriculture.

THE Missouri Geological Survey has been in trouble, and we regret to learn that Mr. Arthur Winslow has been forced by circumstances to retire from its directorship. In his successor, however, Dr. C. R. Keyes, who has lately done much good work on the Iowa Survey, the State secures a skilled observer already well acquainted with the geology of Missouri.

THOSE interested in the United States Geological Survey will find an appreciative notice of Major Powell's administration in the May-June number of the *Journal of Geology*. The writer, Professor T. C. Chamberlin, dwells chiefly on the value of a topographic survey inspired by a feeling for the genesis of physiographic features.

THE "Societá Geologica Italiana," which was started in 1881 at Rome, now numbers 223 members. In the last number of its *Bolletino* (anno xii., fas. 4) will be found a series of papers dealing with the geology of Piedmont, more especially with the fossil Foraminifera, Coniferæ, etc., and a geological bibliography of some 1,100 entries.

THE "Society for the Study of the Amur Regions" has now become the nucleus of a new branch of the Russian Geographical Society. It will have its headquarters at Khaborovsk, and be known as "The Amur Branch." A yearly subsidy of 2,000 roubles will be given by the Government.

THE "Recent Territorial Arrangements in Africa" is the title of a short paper by Mr. Ravenstein in the *Geographical Journal* for July. In it are given two maps, one of the Congo State, and another of the Somali-land area, to illustrate the present arrangements come to by the eagles over the carcass of Africa.

IN his anniversary address delivered to the Royal Geographical Society, Mr. Clements R. Markham referred to the new catalogue of the library of the Society, which will be in the hands of fellows some time this year. This catalogue has now been arranged in one alphabetical order, and there will be two appendices, the first containing an alphabetical list of all the collections of voyages and travels, with an analytical table of contents to each volume; the second appendix containing anonymous and periodical literature arranged in geographical order. These catalogues have been prepared by Dr. Mill, Mr. Vincent Hawkins, and Dr. Murie.

A still more useful catalogue is being prepared for the same Society by Dr. Mill and Dr. Murie. That is a subject catalogue which is to be at once exhaustive, systematic, and exclusively geographical. Such a book as this, if properly carried out, will be an invaluable contribution to geography, serving as a guide to workers in all parts of the world. But, of course, it involves great labour. The number of titles to be indexed Dr. Murie calculates at 110,000, and this will print into something like 5,000 pages octavo. It is hoped that this book will be ready in about two years, and one might perhaps indulge the hope that Dr. Murie will keep an especial eye on bibliographies.

DR. R. LLOYD PRAEGER has written in the July number of the *Irish Naturalist* a sketch of the history of the Belfast Naturalists' Field Club. This is but the first of what must be a most interesting series of histories of the Irish Natural History Societies, and we shall await the succeeding papers with interest. The Belfast Naturalists' Field Club was the outcome of some courses of lectures on Natural Science by Mr., now Professor, Ralph Tate, and was started in 1863. Since then it has steadily increased in prosperity and usefulness, and has published many interesting and valuable papers in its well-known but somewhat complicated "Proceedings" and "Appendices." The membership is now just about 500.

PART 1. of the fourth volume of the Actes Soc. Sci. Chili has just reached us. Mr. Boulenger has a paper on the fresh-water perches of Chili, and Dr. L. Vergara Flores one on the cranium of an aboriginal Bolivian. The Society numbers some 250 members, and publishes in its "Actes" many valuable observations relating to Chili. The library seems to be growing rapidly under the care of Dr. Briones. Parts 4 and 5 of volume iii., and parts 4 and 5 of volume ii. of the "Actes" will appear shortly, and then these volumes will be complete.

IN a paper read before the Royal Irish Academy, Mr. R. J. Ussher shows that the Golden Eagle still breeds in Western Mayo, Donegal, Galway, and Kerry. The White-Tailed Eagle has been observed in Mayo and Kerry. The Pelegrine Falcon breeds fairly commonly throughout Ireland, but the common Buzzard is rare. Tree Sparrows also breed in co. Dublin, and are increasing in numbers. The Raven is everywhere rare, and the Bittern is now never to be seen.

DR. C. E. STIRLING, F.R.S., has contributed to *Nature* (June 21 and 28) an account of his remarkable discovery of the remains of *Diprotodon* and other extinct vertebrata at Lake Callabonna, South Australia.

CORRESPONDENCE.

Sewage or Filth-Fed "Fish."

Bordering on our coast, the sea being contaminated by ever-increasing sewage-outfalls, effluvial refuse and dirty rivers—too often only open drains artificially fouled from source to mouth—may sooner or later cause the *extinction* of the British trout and British migratory salmon by stopping their sojourn and spawning in such sewage-spoilt streams.

It was estimated in 1882 that local sewage and refuse had already so polluted and poisoned the rivers of England—reckoned roughly at about 60,000 square miles—that then (1882) upwards of one-sixth of these waters were incapable of supporting fish-life.

On the other hand, like some sea birds, many salt- and fresh-water fish frequent and are fond of a moderate quantity of, sewage, whose warmth, products, and contents also favour local aquatic vegetation.

Sewage-fed oysters, besides other aquatic and amphibian animals usually eaten either absolutely raw or else insufficiently cleaned and cooked, cause avoidable parasitic diseases, fatal fevers and poisoning, which details are discussed in my 1893 treatise on "Foul Fish and Filth Fevers," that the United States Fish Commission will shortly publish, and my article on "Sewage-Fed Fish" in *Public Health* of June, 1894.

It is imperative that immediately a Royal Commission, a Select Committee, or at least a Parliamentary Return should be granted to inquire into and report upon remedies to diminish the dangers to health, and the damage to property, food, and sport caused by the augmenting sewage pollution of our inland and coastal waters.

J. Lawrence-Hamilton, M.R.C.S.

Sun or Moon?

Is not *Orthagoriscus mola* usually considered a sun-fish (*vide* Günther "Study of Fishes," p. 690) not a "moon-fish," as stated by your reviewer on p. 71?

11 Wellington Road, Brighton. Edward Crane.

July 7th, 1894.

[Sun-fish or Moon-fish.—The paper we referred to was "Note sur un *Poisson-Lune* (*Orthagoriscus mola*, *L.*), de grandes dimensions, capturé sur les côtes du Portugal." What *we* know as the moon-fish is *Ephippius gigas* of the Antilles, but there is no reason for supposing that *Orthagorisci* are called sun-fish in all parts of the world.—Editor.]

A Three-Toed Passerine.

Sir,—I am much indebted to you for pointing out in your Editorial Note on my paper (Natural Science, vol. v., p. 10) the interesting fact of the persistence of the *flexor longus hallucis* in three-toed birds. The note contains, however, a slight mistake, viz., the statement that there is no three-toed passerine bird. *Cholornis*, a genus believed to be allied to *Suthora*, has but three toes. The suppressed toe, however, is unfortunately not the hallux, but the fourth toe. For a three-toed passerine of the kind you implied, I fear we must wait till an abnormality occurs.

Frank Finn.

TWO CORRECTIONS.

WE are indebted to Miss AGNES CRANE and to another correspondent for pointing out that the paper by Dr. Meyer referred to in our last issue (p. 14) is not a new publication, but the first part of vol. iv. of the "Abhandlunge und Berichte des K. Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden." We are indebted to Miss Agnes Crane also for reminding us that the Senior Editor of the "Country Month by Month" is not the "Son of the Marshes," but Mrs. Owen, who has herself edited the writings of the "Son of the Marshes."

EDITOR.

TO CORRESPONDENTS.

All communications for the EDITOR *to be addressed to the* EDITORIAL OFFICES, 5 JOHN STREET, BEDFORD ROW, LONDON, W.C.

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NATURAL SCIENCE.

SPECIAL ILLUSTRATED SUPPLEMENT TO NO. 30, AUGUST, 1894.

Taxidermy as a Fine Art.

IF any doubt the value of that connection between science and art to which we have referred on p. 90, then a glance at the fascinating Report by Dr. Shufeldt, which we reviewed in our July number (pp. 58–60), would convince them of their error, at least so far as Taxidermy is concerned. Dr. Shufeldt's plea is throughout for a more artistic rendering of the stuffed and modelled animals and groups in our museums; and when we inquire how this desirable result is to be attained, we find that it is solely by holding the mirror up to Nature herself. That this has not always been done is proved, if proof be needed, by several of the illustrations to the Report; while that it can be done by those with a wide knowledge of nature, artistic feeling, and command of technique, is sufficiently evidenced by many other of the beautiful plates in the book. Through the kindness of Dr. Brown Goode, Assistant Secretary of the Smithsonian Institution, we are now enabled to present our readers with a selection from these plates, to many of which we alluded in our review.

The specimen of *Octopus vulgaris* (Pl. I.) is a gelatine cast taken from a plaster mould, and then faithfully coloured according to nature. The mould was made, as is usual in these cases, not from the animal itself, but from a carefully prepared model, which in this instance was based on a figure by Verany. "It is hard," says Dr. Shufeldt, "to realise what a perfect representation one of these finished gelatine casts gives of the living animal; and, the cast being perfectly pliable, it still further enhances the resemblance to the original."

The Skate, *Raia erinacea* (Pl. II.), is a plaster cast taken from the animal, and coloured, the eyes and minor appendages being added after the cast is made. Some such process as this is the only one by which the large cartilaginous fishes can be reproduced with any marked fidelity to nature and fit for a first-class museum. "Rays,"

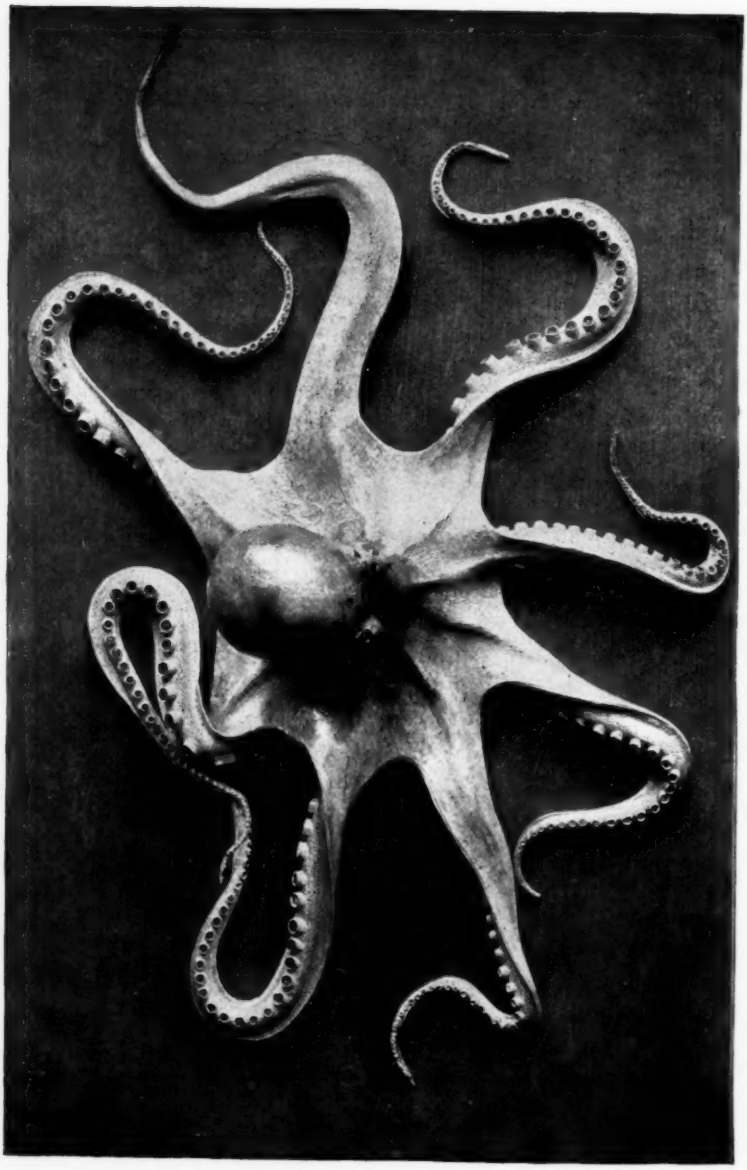
says Mr. Hornaday, "are the meanest of all subjects that vex the soul of a taxidermist. Such abominable animated pancakes, with razor edges that taper out to infinite nothingness, were never made to be mounted by any process known to mortal man. To mount the skin of a vile ray, and make it really perfect and lifelike, is to invite infinite shrinkage, rips, tears, warps, defeat, and humiliation at the hands of your envious rivals. . . . The best way to mount a ray is to make a nice plaster cast of it, paint it, and then bury the accursed ray in a compost heap."

The Rattlesnake, *Crotalus adamanteus* (Pl. III.), is an example of the beautiful plaster casts of reptiles, made by Mr. Joseph Palmer, which are a striking feature at the National Museum at Washington. "With tail elevated, and the reptile thrown into natural coils, partly within the recess of the spreading roots of a large tree, we have," says Dr. Shufeldt, "an accomplishment in plaster, the equal of which for that particular snake I do not believe to be extant."

Lizards, owing to the delicacy of their details, are far more difficult things to cast. "Nevertheless the plaster casts of some of the larger lizards leave us nothing to be desired in that art. A truly magnificent thing is seen in the plaster cast of *Tupinambis*. It would seem to be perfect in every particular." (Pl. IV.)

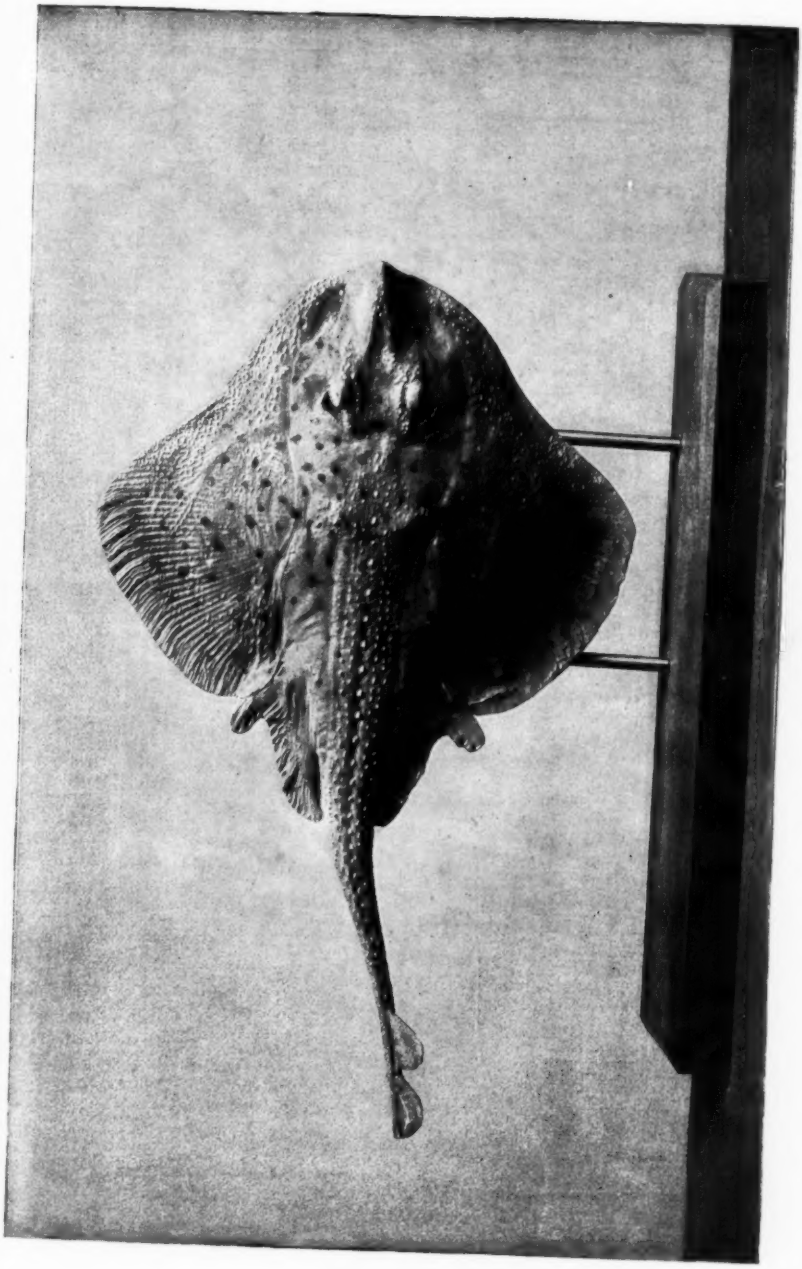
The figures of the Great Auk both represent the same specimen, which is owned by the Museum at Washington (Pl. V.) We again quote Dr. Shufeldt. "A figure of this as first mounted by some ancient bungler is shown. No living auk in good health ever stood in that position; but, thanks to what art can sometimes accomplish in these days, this outraged bird was not destined for all eternity to stand as a drum-major at dress parade. It was determined to have it remounted; an operation, owing to the age of the specimen and the lack of knowledge as to what condition the skin might be in, that required a full measure of judgment. The work of remodelling was accomplished by Mr. Wood." The result is that the extinct fowl "presents a far more respectable appearance, and is certainly posed in a far more natural attitude, though judging from Audubon's plate of it, I believe it still to be not a posture this auk was wont to assume. Still it was most assuredly the very best that could have been done under the circumstances."

The head of a Tiger (Pl. VI.) illustrates how well the great difficulties encountered in representing the mask of a living animal can be overcome. On this hear again the words of Dr. Shufeldt: "One who has not seen the feat performed in one of our larger museums can have but little conception of the skill required in handling the facial expression and all the structures that enter into the mouth parts. The skinning of a tiger's tongue and preserving it so as to make that organ resemble the original as it appeared in the living subject; the cleaning of the teeth; the blending of the black part of the lips with the delicate pink gums inside; to make the animal grin and not smile,



OCTOPUS (*Octopus vulgaris*).

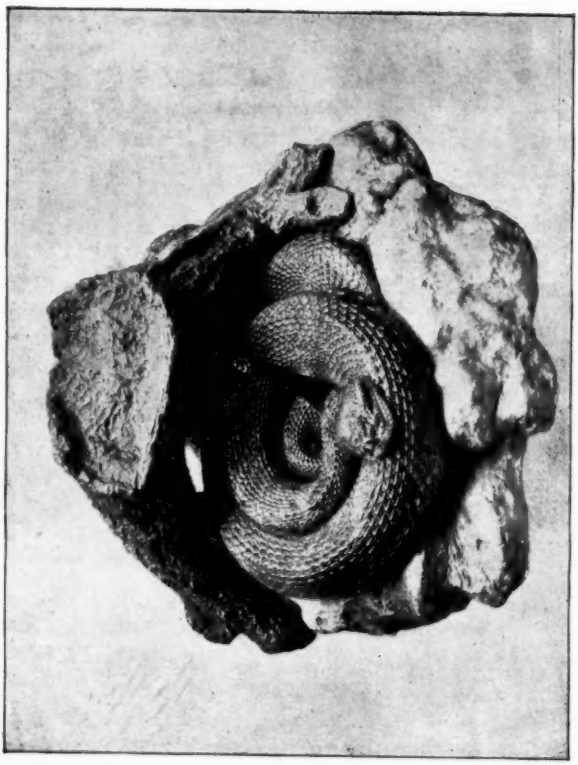
From a gelatine cast; reduced. U.S. National Museum.



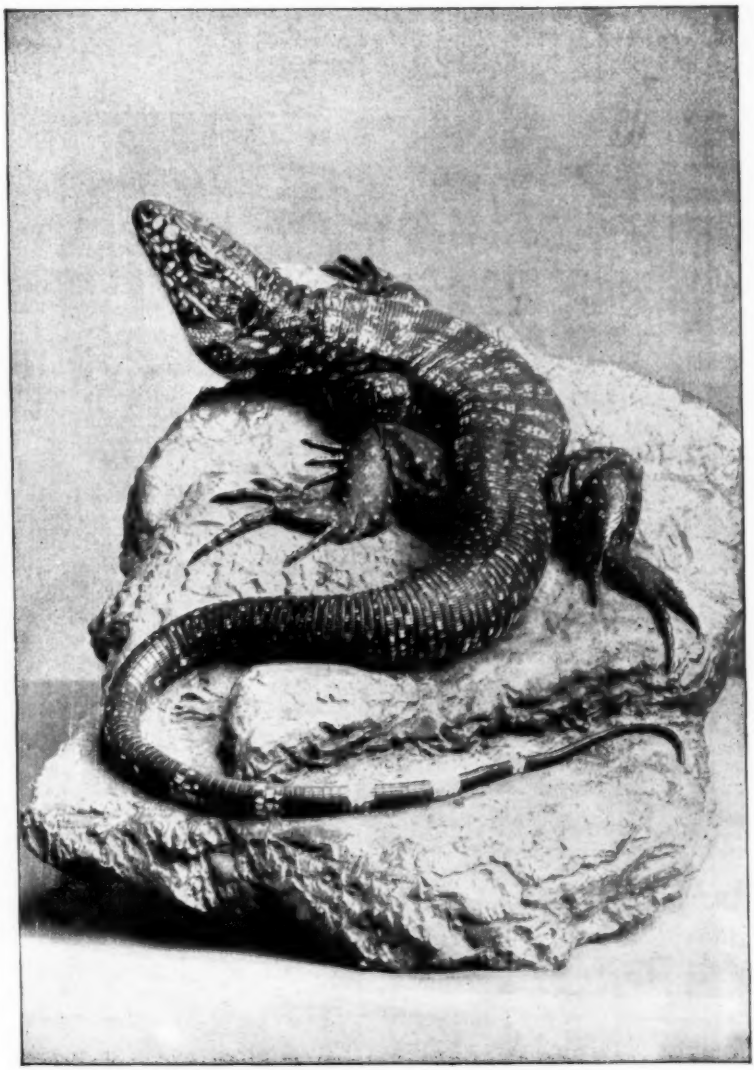
SKATE (*Raia erinacea*).

From a plaster cast; greatly reduced. U.S. National Museum.

From a gelatine cast; reduced. U.S. National Museum.



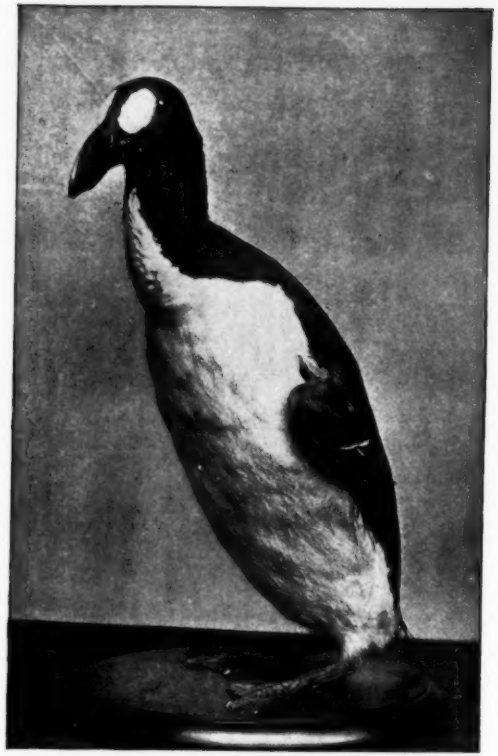
RATTLESNAKE (*Crotalus adamanteus*).
From a plaster cast; greatly reduced. U.S. National Museum.



TUPINAMBIS TEGUIXIN.

From a plaster cast; reduced. U.S. National Museum.

As first preserved.

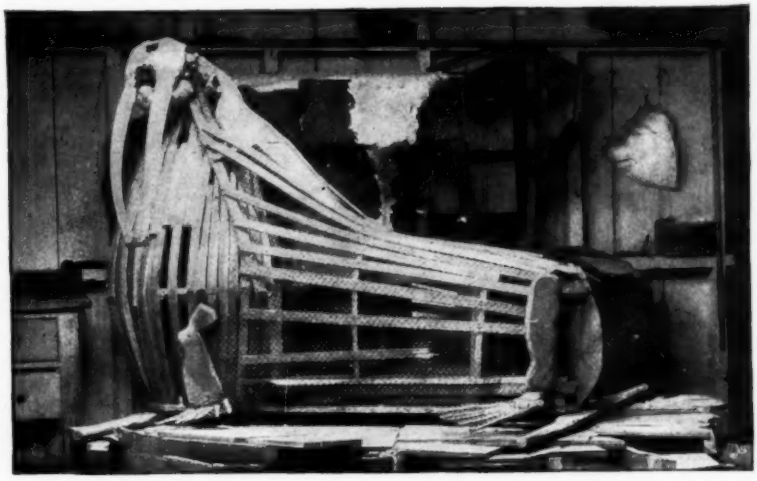


As remodelled by Mr. Nelson R. Wood.

THE GREAT AUK (*Plautus impennis*).
U. S. National Museum.

HEAD OF TIGER (*Felis tigris*).
U.S. National Museum.

HEAD OF ZEBRA (*Equus burchelli*).
U.S. National Museum.



MANIKIN FOR A WALRUS. (Partly completed.)

MALE WALRUS (*Odobænus obesus*). (Nearly completed.)
U.S. National Museum.

HEAD OF ZEBRA (*Equus burchelli*).
U.S. National Museum.

and to lend to the eyes the flash of anger, are all accomplishments that demand of the artist his best judgment, knowledge, skill, and, what is more, his infinite patience." Hear also that eminent artist in this line, Mr. James Hornaday. "The large Felidæ are the finest subjects for the taxidermist that the whole animal kingdom can produce. They offer the finest opportunities for the development of muscular anatomy, and the expression of the various higher passions."

A specimen in which difficulties of a similar nature have been admirably coped with is the Burchell's Zebra, of which the head is shown from the side in Plate VII. This is thus described by Dr. Shufeldt.—"The animal has been given an attitude indicative of moderate movement, with the evident idea in its mind of making an attack or standing at bay, in which he will use his teeth to bite—a habit so familiar to us in some cases of vicious horses. The short mane is semi-erect, the ears are thrown back, the eye looks the owner's intent, while the quivering and nearly rigid lips drawn apart show the glistening upper 'nippers' and the crowns of the lower ones; the nostrils are somewhat closed by the elevation of the superior lip; finally the entire rendering of the whole animal is most perfect in all particulars."

The two figures of the Walrus on Plate VIII. are of exceptional interest. This animal is now exceedingly rare and on the very verge of extinction. Familiar though it has been to us from our earliest childhood, yet we have learnt of late that the pictures of it in works on zoology and natural history, "even in so good and generally correct a work as Brehm, are glaringly false." Only in the last few years have truthful drawings, made from actual observation by Mr. H. W. Elliott, been available for the taxidermist to take as his models. According to Dr. Shufeldt, the specimen of this colossal mammal at the National Museum in Washington "was mounted in the light of all the improvements and skill modern taxidermy could bring to bear upon the undertaking, and the success was complete. It constituted, when finished, one of the grandest subjects the Smithsonian sent on to the Government exhibit at the Columbian Exposition." All opinions, however, are not so favourable; for Dr. W. H. Dall, as already quoted in NATURAL SCIENCE (vol. iii., p. 337), said,—"A fine walrus might have been more lifelike if the taxidermist had had a better guide than Elliott's caricatures of this unfortunate animal, which, in addition to extinction, seems to be doomed to posthumous misrepresentation." The figures, whatever may be the accuracy of the specimen, serve to illustrate the mode of stuffing by means of a manikin, which, especially in the case of hairless animals, is often covered with clay, which can be worked into shape after the skin has been put over it.

In selecting the plates for this article, we have paid but small attention to the many beautiful illustrations of birds. In respect to

bird-groups our home museums do not require much teaching, though even they have yet to learn that a bird can be mounted in the most natural manner on an ordinary museum-perch or stand. It is in preparing the other classes of Vertebrata and the Invertebrata that American taxidermists take the lead, and it is their excellence in this direction that we have endeavoured to set forth as an example. We cannot, however, go so far with Dr. Shufeldt as to look forward to a time when museums shall display in monster cases, picturesquely arranged, the faunas of entire regions or the animal and plant life of various geographical areas. Such a method of exhibition leads, almost certainly, to hopeless incongruities, and prevents a proper inspection of the specimens exhibited. The scene-painter must not interfere with the scientist. A museum is a palace of truth before it is a palace of art.

It is particularly interesting to note the enormous development of the art of taxidermy in the United States which characterises a quite recent period. This is due, in Dr. Shufeldt's opinion, to the stimulating influence that the World's Columbian Exhibition had upon every art and industry, an influence, one may add, that extended far beyond the limits of the great republic. It was not, however, merely the desire to rival other institutions and countries that gave so great an impetus to the art, but the fact that a sufficient appropriation of the needful dollars enabled their true strength and best work to be put forth by such men as F. W. A. Lucas, Joseph and William Palmer, Nelson R. Wood, Henry Denslow, A. H. Baldwin, George Marshall, A. Z. Shindler, and J. E. Benedict, who form part of the enthusiastic staff at the National Museum of the United States of America.